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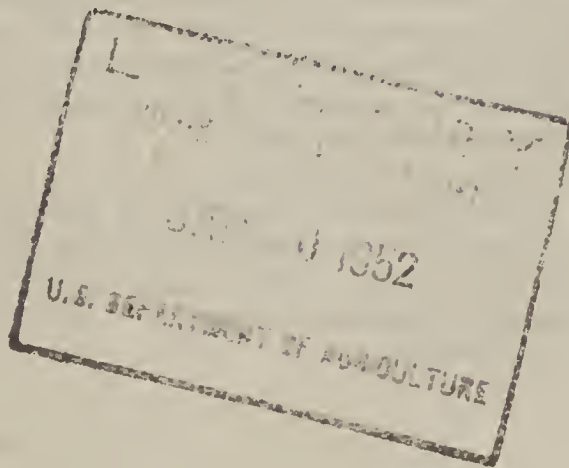
REPORT OF THE CHIEF, 1950/51

OF

THE FOREST SERVICE

1951

X NATURAL ENEMIES
OF TIMBER ABUNDANCE



UNITED STATES DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE,

FOREST SERVICE,

Washington, D. C., September 15, 1951.

HON. CHARLES F. BRANNAN,
Secretary of Agriculture.

DEAR MR. SECRETARY: If our forests are to continue productive, if they are to keep on providing their many benefits and services to the people of the United States, protection of these forests from needless damage by their natural enemies is of basic importance.

Fire is a familiar natural enemy of the forests. Many people are not aware, however, that insects and diseases cause a greater loss of merchantable timber each year than does fire. A fungus disease has all but wiped out one of our finest native trees, the American chestnut. Another disease threatens our valuable white pine. A bark beetle is threatening Engelmann spruce stands throughout the central Rockies, and a budworm is a threat to a vast amount of valuable timber in the Northeast and Northwest. In epidemic outbreaks, such pests can cause tremendous destruction.

During the past 40 years we have made substantial progress in reducing forest fire damage. We have not made corresponding progress in the reduction of losses from forest insects and diseases. Such losses, indeed, have increased. We now have enough technical know-how, however, to accomplish effective protection against some of the serious insect and disease pests. For others, such as "little leaf" of the southern pines and "pole blight" of the white pine in Idaho, we do not. Expanded research, to produce knowledge that will make possible more effective and economical control, is badly needed.

For these reasons, I wish to call special attention to the problems of forest insects and diseases in this report. It is important that we recognize the menace of these pests, and that we give adequate attention to their control.

Protection of the forests from their natural enemies is a first essential in the national program of forestry. It is equally essential that we have good management and wise use of the forest resources. Man, if he handles the forests unwisely and exploits them destructively, can be their greatest enemy.

Sincerely,



LYLE F. WATTS,
Chief, Forest Service.

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**Report
of the
Chief of the Forest Service
1951**

NATURAL ENEMIES OF TIMBER ABUNDANCE

We Need Plenty of Timber

Our country needs an abundance of forest products. We in the United States use about 40 percent of the world's total output of lumber and well over half of the world output of pulp and paper products. Our consumption of all wood products per person is more than three times the world average.

This high per capita consumption of wood in the United States reflects our high standard of living. A plentiful supply of forest products, indeed, is one of the requirements of our standard of living. We require enough wood to meet our continuing demands for new houses, for newspapers and books, for rayon dresses, photo film, and hundreds of other useful things that come wholly or partly from trees. Wood is one of the important raw materials of industry, and an abundant and continuing supply of it is therefore one of the requirements for a high level of industrial production and employment.

At the start of World War II, some of the war production planners were thinking of wood as a handy substitute for some of the critical war materials. Before the war ended, they were wondering where they could find substitutes for wood. That mistake must not be made again. Forest products are now classed among the essential materials in the current defense program. They are needed for our national security.

The forests have recreation values of great importance, too. Still another forest "product" is fish and game. Forest ranges in the West and South furnish grazing for millions of head of domestic livestock. By far the most important service of the forests in many parts of the country is to protect the watersheds and thus to reduce the danger of floods, erosion, and sedimentation, and to help provide dependable supplies of water for irrigation, power, and domestic use.

This year's report gives special attention to natural enemies of the forest which threaten all these great values and services. The most important natural enemies are insects, diseases, and fire. It is desired especially to call attention to the destructive insects and diseases. Most persons know what fire can do to the forest. Many are not aware that insects and diseases cause even greater losses.

The Resource We Once Had

What is now the United States was once endowed with a forest wealth almost beyond imagining. Forests covered nearly a billion acres, stretching almost unbroken from the Atlantic seaboard to the Great Plains, and over large areas at the higher elevations of the Rocky Mountains and the Pacific Coast regions. There were hundreds of different kinds of trees, many of them producing excellent woods for various uses, many of them growing to great size.

For more than 2 centuries after the first colonists came to American shores, the main concern was to push back the forest to make room for settlement. The forests provided the material to build farm and village homes and furnishings. Enormous quantities of timber were wasted as the settlers cleared land for farming. Then, as the cities grew and industries developed, a great period of lumbering began. Exploitation of the forests was on a Paul Bunyanesque scale; burly loggers performed giant feats with ax and saw to "let daylight into the swamps"; great river drives brought logs by the thousands to the mills to meet the ever-increasing demands of a growing Nation for lumber. Even when all the merchantable timber in one locality was cut out and the local sawmill had to close down, there was always more timber over the next hill. High-grading of the choice trees left many forest stands in poor condition. Clear cutting followed by uncontrolled fires devastated the forest growth on millions of acres.

The forests contributed mightily to the development of our Nation. They built great cities, great industries, and great fortunes. Timber was used lavishly, and wastefully, because it was abundant and cheap.

This country grew up in an atmosphere of abundance. Our democratic way of life has thrived on it. And despite some of the pressures of undersupply now being felt, we still should think in terms of regaining and maintaining abundance.

Nothing is gained by lamenting the past waste in the use of our forest resources. What we must deplore is that forest resources were used, and still are being used, with too little thought of replacement or perpetuation of the supply. To have permanent forest abundance we must put our land to work.

Forests on the Downgrade

Following World War II, the Forest Service made a reappraisal of the forest situation in the United States. The facts brought together in this reappraisal showed very definitely that our total forest resource is in unhealthy condition, that we are heading for a period of tighter supply of some of our needed forest products. In fact, we are already experiencing shortages of certain kinds of forest products, such as large-size, high-grade lumber and timbers, and the kinds of wood needed for some of the specialty uses. Lumber prices have skyrocketed to some three times what they were 10 years ago. They have risen much faster than the prices of other building materials, reflecting in part at least the fact that our supply of good quality, readily accessible merchantable standing saw timber is getting scarcer. Suitable new locations for large-scale logging operations are increasingly hard to find.

We are not growing saw timber as fast as we are using it. Saw timber is timber big enough and of the right kinds to make lumber, whether used for that purpose or not. Eighty percent of all timber products are cut from trees of saw-timber size. The reappraisal showed that the total annual drain of saw timber is exceeding the total annual growth by 50 percent. That was on the basis of the 1944-45 rates of drain and growth. Drain includes timber cut for commodity use plus losses from fire, insects, diseases, etc. Ninety percent of the total drain is "commodity drain"—timber cut for use.

A decrease in the volume of saw timber was to be expected, of course, as old-growth forests were being replaced by second-growth. There is a near balance between drain and growth for all timber, including that less than saw-timber size. But most of the drain is in saw timber, particularly the better softwoods, whereas much of the growth is in small, low-grade trees and inferior hardwoods. We are eating heavily into our forest capital of good-quality growing stock.

We have in the United States about 460 million acres classed as commercial forest land, bearing or potentially capable of growing merchantable timber. On the average, the annual saw-timber growth on this land is only about half of what it could and should be. The quality of the timber has deteriorated over wide areas; millions of acres now bear only low-value, scrubby trees. Much of the land is understocked; millions of acres of forest land capable of producing good timber crops are very poorly stocked.

For 300 years, our Nation has obtained its timber largely from the virgin forests that nature provided, or from volunteer second-growth on cut-over or burned-over lands. Only within the past half century has an appreciable effort been devoted to growing timber as a crop. Now that the end of the virgin timber is in sight, we shall have to rely more and more upon what we grow.

We face a difficult task if we are to meet forest products needs during the current defense emergency without further seriously weakening our forest resource base. Even more difficult will be the job of building up the timber growing stock necessary to assure a sustained, abundant timber supply for the future.

Protection Is an Essential Step in Forestry

Our forests have enemies that constantly threaten them. Fire each year takes a tremendous toll, destroying billions of young trees and injuring bigger ones, killing wildlife, blackening recreation areas, and damaging watersheds. Windstorms sometimes lay low the trees over large tracts; ice storms may do great damage. Numerous insects and diseases attack trees and in many areas they cause greater losses of timber than do fires.

We are earnestly concerned these days about protecting our country from dangers that threaten us from the outside. But we must not overlook enemies within our own borders. Adequate protection of our forests from their natural enemies will save a very great volume of timber. It will help greatly to conserve water and reduce floods.

Protection is not the complete answer to the forest problem. But it is an essential step in building up and maintaining our forest resource, one of the basic resources upon which our Nation's strength and welfare depend.

PROTECTING THE FORESTS FROM FIRE

In the decade that ended in 1950, more than 1,824,000 forest fires occurred in the United States. They occurred at the rate of about 500 per day. They burned over an average of 21,622,000 acres each year, an area larger than the State of Maine. They caused direct damage to timber and property estimated at \$392,000,000. They took scores of human lives.

The great majority of forest fires, especially in the East and South, are "ground fires," burning mostly in the duff or leaf-litter on the forest floor. Promptly attacked with adequate manpower and equipment, such fires are fairly easy to control. But nearly every small forest fire is potentially a big one. If a combination of dry weather and high winds occurs, a forest fire may spread with explosive violence, roaring through the trees faster than a man can run, generating waves of heat and gas that fan the flames to even greater fury. A really bad forest fire is a terrifying thing. It will destroy everything in its path.

That was what happened when the Peshtigo fire in Wisconsin in 1871 wiped out whole settlements and killed 1,500 persons; when the great Idaho fires of 1910 wiped out several million acres of virgin timber in a few days. It happened when the Tillamook fire in Oregon in 1933 killed as much timber as the entire United States lumber cut of the preceding year. It happened in Maine in 1947 when forest fires destroyed more than 800 homes. Large, destructive fires occurred in the Western States in 1951. It can happen again. Given the right combination of weather and fuels, big and destructive forest fires are still possible in many parts of the United States.

Losses of merchantable timber and property are direct, tangible, and readily apparent. Forest fires, however, cause many damages not so easily recognized. Fire may kill the tiny young trees in a forest and so destroy the mature timber crop of 20, 50, or 100 years hence. Fire may alter the character of a forest. As a result of fire, for example, a forest in which valuable pines or spruces predominated may in time become mostly a scrubby growth of inferior species. Repeated fires have made many millions of acres of forest land in the United States into unproductive wasteland.

Even a small, smoldering surface fire may leave fire scars on the trunks of trees, where wood rots may enter. Fire-weakened trees may be attacked by insects, or more easily thrown by the wind. A woodland owner thus may suffer losses in his cash-crop trees, even though the fire actually kills very few of them.

Fires destroy valuable forage on western ranges. When range land burns, ranchers often are forced to find other feed for their livestock for many months. And exposure of the soil when grass and brush is burned may cause erosion and floods.

Storm runoff is greatly accelerated when fires burn the vegetation on steep slopes. A flood that caused \$347,000 worth of damage in Salt Lake City in 1945 came directly from a 600-acre burned area on the grass-and-brush-covered hills north of the city. The Montrose, Calif., flood of 1934, that caused \$5,000,000 damage and took 34 lives, came from a watershed area that had been burned about a month earlier. Following the big Columbia River flood of 1948, watershed technicians

found ample evidence that much water would have been held back until after the flood peaks had passed and damage would have been far less if millions of acres in the upland watersheds had not been depleted of their plant and forest cover, mainly by forest fires.

Fires have impaired the ability of watersheds in many parts of the United States to absorb rainfall and hold back runoff. Along with unwise land-clearing, destructive logging, overgrazing, and other watershed abuses, fire is responsible for a vast amount of flood damage, for aggravated problems of water supply, and for the silting of reservoirs, stream channels, and harbors with millions of tons of sediment eroded from the land.

Forest fires kill many game animals and birds. Wood ashes washed into streams after a fire sometimes kill large numbers of fish. Destruction of the vegetation along stream banks may cause water temperatures to rise and make the stream unfit for trout. Sedimentation from fire-damaged watersheds has ruined many good fishing streams.

Forest fires can hurt tourist and recreation business. Vacationers are not likely to flock to areas where forest fires are reported to be burning, nor to spots where the scenery has been blackened by flames.

Many railroad lines, highways, and telephone and telegraph lines pass through forest areas, and fires can therefore disrupt business communications and railroad and truck transportation.

Losses such as these, and many other indirect and intangible losses caused by forest fires are not easily measured in terms of dollars. But in the aggregate they represent a huge drain on the resources and manpower of the Nation. To the losses caused by fires must be added the costs of controlling them, to keep the damages from amounting to an even greater total.

A Complex Problem

In few parts of the world is the problem of keeping the forests from burning as complex and difficult as it is in the United States. In this country there are regional variations in the seasons of greatest fire danger. The normal fire seasons in the forests of the eastern and central States are spring and fall. In early spring, soon after the snows have melted and before the deciduous trees have leaved out, a few days of sun and wind can dry out the forest litter and create a high fire hazard. After the leaves fall from the trees in autumn, the forest floor is again exposed to sun and wind, and the dry, new-fallen leaves are added fuel. The fire season may extend through the winter months in the deep South. Throughout the Western States, the dry summer months are normally the period of forest-fire danger.

Changes in fuels, weather, or degree of exposure to sources of fire can alter the situation locally or regionally. Prolonged droughts may bring periods of danger during the summer months in portions of the East, or delayed snows may mean that the fire season extends into the winter. A few years ago, foresters had to fight a brush fire in northern California when there was several inches of snow on the ground.

Even within a normal fire season, forest-fire danger fluctuates widely. A fire-control organization must be geared to meet a threat which today may be half what it was yesterday, but which may jump to a hundred times that of today by next week. New activities in

an area may alter the fire problem. Changes in the character of a forest or range—in species of plants, in growth or decay—have their effects.

The forest-fire hazard has increased in recent years throughout much of the West. Epidemic attacks by insects have killed timber over large areas in Colorado, Montana, Idaho, and Wyoming. The bug-killed timber is in many places a tangled mass of fallen trees, where fires can burn hot and spread fast. Heavy accumulations of logging slash intensify fire-control problems in many western forests. And increased industrial and recreational use of the forests means greater numbers of people in and near the forests who might start fires.

Causes of Forest Fires

Most forest fires are caused by human carelessness, negligence, or ignorance. Forest-fire prevention, therefore, is mainly a problem of improving people's ways, of creating a better understanding of the importance of forests and a sense of personal responsibility on the part of every citizen to safeguard the forests from damage. That is not an easy job. A city dweller used to paved streets, for example, does not easily change his smoking habits when he goes into the woods.

During the 5-year period from 1946 to 1950, the causes of fires reported on protected forest and watershed lands of the United States were as follows:

<i>Cause</i>	<i>Percent</i>
Incendiary -----	31
Smokers -----	21
Debris burning -----	17
Lightning -----	8
Railroads -----	5
Campers -----	4
Lumbering -----	2
Miscellaneous or unknown -----	12

Incendiarism, the leading cause of forest fires, is mainly a problem in the South. Of the 40,122 forest fires of incendiary origin reported in 1950 on protected lands, 36,566 were in the Southern States. Persons sometimes start forest fires deliberately to spite a neighbor, to obliterate evidence of a misdeed, or because of a grudge against public authorities. Children, and sometimes adults with immature minds, may set fires in the woods for the excitement of it. But comparatively few man-caused forest fires are set maliciously.

Annual woods-burning has long been a tradition in many rural sections of the South. The woods are fired every spring to "green up the grass," to get rid of underbrush, or because of mistaken notions that ticks or boll weevils can be eliminated by woods-burning. Any benefits, real or fancied, from such yearly promiscuous woods-burning are usually more than offset by the damages to timber and watershed values. Ideas and customs of long standing will have to be changed before this kind of woods-firing can be wholly eliminated. The problem is one of education, coupled with better fire laws and stricter law enforcement.

Debris burning causes many fires in farm woodlands. Too frequently, fires started by landowners to burn trash or get rid of brush

or weeds get out of hand and spread to the woods. A number of the States still lack effective laws to foster safe practices in the burning of debris. Burning off weeds from fields or clearing "new ground" by burning, incidentally, frequently destroys much organic matter that might better be plowed into the soil.

Careless smokers were responsible for 18,259 fires on protected forest lands in 1950. Many of these are started when people toss cigarette butts or matches from automobiles traveling in forested areas. Others are caused by hikers, hunters, fishermen, or woods workers who are careless in disposing of their smoking materials. The Forest Service has imposed rules in many of the national forests that prohibit smoking except at improved campgrounds and other designated safe areas. Many of the States now have laws against throwing lighted materials from automobiles. Smoker-caused forest fires will be wholly eliminated, however, only when millions of smokers have become fire-conscious and have developed the will to improve their smoking habits.

Campers and picnickers who build campfires in unsafe places or who abandon their campfires while still burning are another cause of forest fires. A smoldering campfire left unextinguished can be fanned into flame again if the wind rises, and its sparks may quickly ignite the surrounding woods. Educational efforts to induce campers to douse their campfires thoroughly with water before they leave them, and prosecution of persons responsible for forest fires through negligence with campfires, are reducing the number of fires from this cause.

Railroad operations formerly caused many more forest fires than they have in recent years. Improved spark-arresters and ash pans on locomotives and the conversion to oil burners have reduced the danger from sparks. Many railroad companies now clear their rights-of-way through forest areas and otherwise cooperate with State and Federal forest-protection agencies. The percentage of fires resulting from logging operations also has dropped materially in the past 3 decades. Many timbermen cooperate wholeheartedly; most logging crews observe strict safety precautions; and when bad fires do occur they are usually among the first reserves to be called, and also often the most effective fire fighters. Despite the fact that these industrial fires are relatively few in number, the great damage they frequently do calls for stronger efforts to eliminate them.

Many miscellaneous causes of forest fires have been reported. A few were freak natural causes, such as meteorites, but most of them were the result of human activity.

So, all told, more than 90 percent of all forest fires are man-caused, and therefore preventable. The only important natural and unpreventable cause is lightning, which accounted for about 8 percent of the reported fires on protected lands, Nation-wide, in 1946-50. In the Western States, however, lightning causes a much higher percentage of forest fires than it does in the East. Of a total of 12,393 forest fires in 1950 in the Rocky Mountain and Pacific Coast States, 5,709, or about 46 percent, were lightning-caused.

Summer lightning storms in the western mountain regions often occur with little or no rain. In the northern Rockies and Pacific Coast regions more than 100 fires have been started by a single storm; in the national forests of northern Idaho and western Montana in 1946, Forest Service forces had to fight 1,315 lightning-caused fires in a 2-

month period. Forest fires started by lightning are usually tough to handle; they often occur in rugged, high-country areas difficult to reach and difficult to work in.

Nobody yet knows how to prevent lightning from striking. But advances in knowledge of fire weather are helping forest-protection forces to know when to be on the alert for lightning-caused fires. Adequate and well-equipped forces can control them quickly and hold the damage to a minimum. And recent experiments in "seeding" thunder clouds to cause precipitation have given at least some indication that it might eventually be possible to prevent or control the lightning itself.

Beneficial Uses of Fire

Under certain circumstances, fire can be a useful tool in the forests, if carefully applied and controlled. Research has worked out practicable and safe techniques for using fire to get rid of sagebrush on certain types of western range where topography is not too rough, and thus to aid the natural comeback of desirable grass forage or to prepare the ground for artificial reseeding to grasses. In the southern pine region, controlled burning is being used to aid the regeneration of longleaf pine when heavy growth of broomsedge or other ground cover interferes with natural reseeding. Fire has been found to have a sanitary effect, when properly timed, against the brown spot disease of longleaf pine. Light, controlled burning can sometimes be used to get rid of undesired plants and trees, or to remove heavy accumulations of inflammable ground cover and thus reduce the hazard of destructive wildfire. In the Northwest, broadcast burning at a safe season is often used to get rid of accumulations of logging slash or debris. Such uses of fire, however, should never be attempted except under the direction of experts. Every safeguard must be taken to make sure the fire is confined to the area prescribed for burning.

A great deal more research in this field is needed. But the fact that fire can at times be used beneficially must never be used to condone uncontrolled wildfire in the woods. Because of fire's great potential destructiveness, constant effort to prevent and control wildfire in the forests is a must.

The Status of Protection Today

The forest-fire protection job in the United States involves Federal lands, State- and other publicly-owned lands, and private lands. The Federal Forest Service is directly responsible for the protection of some 180 million acres of national-forest land from fire. This includes federally owned land in national forests in 38 States, Alaska, and Puerto Rico. In addition to the federally owned lands, the Forest Service, under agreements with the States or with individual owners, protects several million acres of intermingled private lands within the exterior boundaries of the national forests. The total area of national-forest land and other land under protection of the Forest Service in 1951 was approximately 209 million acres.

National Forests

In 1950 fires burned over a total of 330,531 acres of national-forest land and other protected lands inside national-forest boundaries (exclusive of Alaska). This was less than two-tenths of 1

percent (0.178 percent) of the area protected. In terms of total protected area it could be called highly effective protection. On a number of national forests, however, the losses far exceeded this over-all figure. More than half of the total area burned was in California, where nearly 50 major fires taxed fire-protection forces to the limit. Arizona and New Mexico national forests also had a severe fire season, with an acreage loss 65 percent greater than the 5-year average.

Such heavy losses in individual national forests greatly hamper the orderly long-term management of the forest resources. In some forests, fires over a period of years have materially reduced the total volume of timber, which means that the allowable annual cut under sustained yield is likewise reduced. This cuts down employment and income in adjacent communities. Multiplied many times over in various forest management units, such losses will have an appreciable effect on the Nation's timber supply. On noncommercial forest lands, heavy burning also has far-reaching effects. Because of fires on chaparral-covered watersheds in southern California, for example, millions of dollars have been expended for flood-control works to cope with accelerated storm runoff. Elsewhere, many reservoirs holding irrigation water or municipal water supplies have lost a part of their capacity, and some have been completely filled with debris, because of siltation speeded up by fires on the watersheds.

The success of fire control, therefore, cannot be judged by over-all statistics. It must be judged by the degree to which fire losses are held below the maximum that can be tolerated on each and every individual forest management unit. And it must be judged not only for 1 year but for a long period—the rotation period of a timber crop, for instance, which may be from 25 or 30 to more than 100 years; or the life of a reservoir, which should be as long as it will be needed.

The Forest Service fire-protection forces and facilities in the national forests today can cope with the fires that break out during periods of normal or better than normal weather. But they are spread too thinly to insure against serious losses when unusually bad fire weather occurs. As a matter of sound business, considering the values at stake, the Forest Service should be enabled to build a fire-control organization of sufficient strength to assure adequate protection of those values.

Costs Go Up

Today it costs more than three times as much to employ a fire-fighting crew as it did in 1940. A crew of fire fighters, with the required crew bosses, truck drivers, tractor operators, etc., that cost \$53.65 per hour on the job in 1940, cost \$170 per hour in 1950. This reflects a general increase in the cost of labor during the past decade. In line with this general increase, the base pay rates of fire-control assistants, lookout men, and other personnel who constitute the bulk of the Forest Service fire-protection force, have nearly doubled.

Another element of the increased costs is overtime. It is necessary to maintain 7-day-per-week service in fire protection; services cannot operate on a 40-hour week only, since forest fires can start at any time and can burn just as hot on Sundays as on weekdays. Establishment of the 40-hour week under provision of the Wages and Hours Act in 1945 meant that pay rates would be raised by 60 percent if the same 7-day-per-week service in fire control were to be maintained that had

prevailed more than 40 years. By careful management and by taking some calculated risks, however, the Forest Service has been able to hold overtime costs to about 16 percent of total protection costs.

The cost of equipment and supplies also has increased greatly during the past 10 years. Fire-protection equipment that in 1940 cost \$100 cost \$191.50 in 1950.

All told, today's forest-fire protection dollar has only about 50 percent of the purchasing power it had in 1940. With not enough funds available to make up the difference, the result has been reduced forces to handle an increased fire-protection load in the national forests. The actual total strength of national-forest short-term fire-protection forces in 1951 was 6,046 men, as against 13,074 in 1940 when Civilian Conservation Corps men were used in protection positions, and 9,301 in 1945, after the CCC program ended.

The 1951 Fire Season

To August 31, the Forest Service fought 8,762 fires in the national forests. The area burned was 307,545 acres, compared with an average of 160,812 acres for the corresponding 8-month period of the preceding 5 years.

Of the 8,762 fires in the first 8 months of 1951, all but 114 were brought under control within the first 24 hours after discovery. The great majority were held to a small acreage, but 1,155 got away to reach class C size (10 to 100 acres) or larger. It was these relatively few big fires that accounted for a large part of the total acreage loss. In nearly every case, these run-away fires could have been held to a small area if adequate manpower and quicker transportation facilities had been available.

The Southwest in 1951 experienced the most critical fire weather of its history. Two bad fires in the Gila National Forest and large fires in the Apache, Lincoln, and Crook National Forests early in the summer burned nearly 91,000 acres. High winds swept the blazes into remote areas, difficult to reach.

In the Lake States, danger conditions in June required emergency manning. The Pacific Northwest had the driest spring and summer since 1922. During late August and September a number of fires raged out of control. Logging operations had to be shut down for long periods. California also was suffering from a serious lack of moisture and suffered many bad fires.

Other Federal Lands

Fire is a hazard, in varying degree, on many parts of the nearly 180 million acres of unappropriated and unreserved public domain land of the United States, including the 147 million acres in grazing districts established under the Taylor Grazing Act of 1934. Much of this land is desert or semidesert, or range and watershed land bearing grass or brush, but about 28 million acres is classed as timber or woodland, including some 4 million acres which bears commercial timber stands. The Bureau of Land Management, Department of the Interior, which manages this public domain land, receives appropriations for fire control and maintains a fire-protection organization. Its fire problem is relatively light on large areas of desert and open range, but on some parts of the public domain, the hazard is comparable to that on adjacent national forests.

In Alaska, there are some 290 million acres of unreserved public lands, under jurisdiction of the Bureau of Land Management. By estimate, about 125 million acres of these public lands are forest lands. The Bureau of Land Management has received only nominal appropriations for fire control in Alaska, insufficient to set up organized protection on more than a very small portion of the public lands in the Territory. Nearly every year, fires burn unchecked over large areas in the Alaskan interior. Only about 25 million acres of heavily timbered land has not been burned. Recent sample plot studies in these unburned stands by the Forest Service's Alaska Research Center showed timber stands that compare with those of northern New Hampshire and Maine. They are worth protecting. By the practice of a little silviculture, foresters can probably increase the timber growth substantially—if fire leaves any of the present forests.

Under a 1937 act of Congress, the Bureau of Land Management also administers the Oregon and California Revested Lands, comprising a little over 2 million acres in western Oregon. The O & C lands are intermingled in a checkerboard pattern with national-forest lands and private lands. Under reimbursement agreements with the Bureau of Land Management, the United States Forest Service and the Oregon State forestry department, which have fire organizations already functioning on adjoining lands, handle fire protection on the O & C lands.

The Bureau of Indian Affairs, National Park Service, and Fish and Wildlife Service handle fire protection on lands under their jurisdiction. The armed services provide protection for more than 2 million acres of forest land in Army, Navy, and Air Force reservations. The Tennessee Valley Authority arranges with various agencies for the protection of some 340,000 acres of forest land acquired in connection with its reservoirs.

The Forest Service cooperates with all these agencies. It makes available to them its research findings and newest developments in fire-fighting equipment and techniques. Fire-protection personnel of other agencies are invited to Forest Service training camps and conferences. Fire Control Notes, a quarterly journal published by the Forest Service's Division of Fire Control, serves all Federal, State, and private forest-protection agencies as a clearing house for information on fire-control methods and equipment.

The Forest Service in turn receives excellent cooperation from many agencies. During emergencies in 1950 and 1951, the Army and Navy furnished men and equipment to help fight a number of bad fires. The Coast Guard aided in aerial detection and scouting in California. In Alaska the Bureau of Land Management furnished men and equipment and the Fish and Wildlife Service provided aircraft to help control fires in the Chugach National Forest. The Bureau of Indian Affairs and the National Park Service cooperated in fighting several California and Southwest fires. State forestry agencies gave excellent cooperation in the joint handling of many large fires. The Weather Bureau cooperated in a special spot-forecasting experiment in the Pacific Northwest. The American Red Cross did outstanding work on many fires.

There were many examples of fine cooperation from lumber, pulp and paper companies, and other forest-products industries, and from

local communities and groups. Cattle-grazing permittees organized for fire duty on the Sequoia National Forest. Nearly every able person in the town of Mount Shasta, Calif., turned out to help during a fire emergency in the Shasta National Forest.

State and Private Forest Lands

Under the Clarke-McNary Act of 1924, the Forest Service cooperates with 43 States and the Territory of Hawaii in providing fire protection to State and private forest lands. Cooperative protection under the act now covers 360,564,000 acres. The total area of State and private forest and watershed land needing protection is 426,694,000 acres, so 66,130,000 acres still remain without organized protection from fire.

On those lands under systematic protection, the area burned in 1950 amounted to less than 1 percent (0.95%) of the area protected. Of the lands still lacking protection, 17.7 percent burned over.

Direct damages to timber and property reported on the 360 million acres of protected forest land were about \$14,000,000. On the 66 million acres still unprotected, tangible damages were estimated at \$26,000,000. These damages, it should be emphasized again, do not include such indirect and intangible losses as those resulting from decay of fire-damaged timber, replacement of desirable tree species by less valuable ones, soil deterioration and erosion, uncertain stream flow, destruction of game, reduced tourist travel, interruption of business.

Generally the State forestry agencies and the United States Forest Service organize protection along similar lines and use the same types of equipment and fire-fighting techniques. State agencies have increased the effectiveness of their protection markedly in recent years. Even though the area under protection has been expanded, the total area of protected land burned averaged less in the last 5 years than in any earlier 5-year period of record.

In many areas, however, protection forces are far too thinly scattered, and present facilities are inadequate even to meet the hazards of a normal season, let alone cope with the "blow-up" conditions of abnormal years. State forestry agencies are also up against higher wage rates and increased costs of equipment. Their costs of fire protection also have gone up.

Fire law enforcement has been given increased attention by the States during the past few years. A total of 7,304 cases were prosecuted in 1950—the largest number of prosecutions in a single year to date. Convictions were obtained in 92 percent of the prosecutions. Rather startling, however, is that in 1950 the number of forest fires of incendiary origin on State and private forest lands jumped 51 percent over the preceding year. This occurred mostly in the South. It showed a need for further intensification of forest-fire law enforcement, as well as increased effort in prevention education.

The cost of providing basic protection for the 426,694,000 acres of State and private forest land needing it was estimated last year at \$48,250,000. Funds available for the protection of 360 million acres of State and private forest land in calendar year 1950 totaled \$30,270,587. State and private agencies provided a net of \$21,140,832; the Federal contribution was \$9,129,755, not including administrative costs. Although the Clarke-McNary Act contemplated that the Federal Government would meet half of the total cost of protec-

tion, the Federal contribution has never matched State and private funds. In 1950, State and private expenditures were 70 percent of the total.

Congress in 1949 authorized increased appropriations for Federal participation in the cooperative forest fire protection program. Increases of \$2,000,000 each year to a maximum of \$20,000,000 for fiscal year 1956 and each year thereafter were authorized. Under this authorization, \$13,000,000 would have been available for fiscal year 1951. The actual appropriation was \$9,500,000.

Advances in Fire-Fighting Methods and Equipment

Use of aircraft has been a big help in implementing a "hit-'em-fast-and-hard" policy of forest-fire suppression. With the cooperation of the Army Air Force, the Forest Service experimented with the use of airplanes for fire detection as early as 1919. By 1930, airplanes were being used by the Forest Service in varying degrees in national forests throughout the West and in the Lake States, and also by several of the State forestry departments. Their principal use at this time was for reconnaissance of going fires and for detection of fires immediately after lightning storms.

Emergency transportation of supplies has become one of the major roles of aircraft in fire control in recent years. During the 1930's the Forest Service developed successful techniques for delivering supplies by parachute to fire crews in remote areas. A simple, low-cost, home-made parachute was designed. A total of 174 tons of cargo was parachuted to Forest Service fire crews in 1950. An additional 204 tons of air freight was delivered field-to-field.

Smokejumpers

At the time it developed successful cargo-dropping techniques, the Forest Service also began thinking about the possibility of parachuting men to fires in inaccessible country. Experiments in actual jumping were conducted in 1939. The tests proved that men could safely land in rough, forested terrain. Using techniques developed through these tests, the Forest Service in 1940 trained 16 fire fighters who volunteered for parachute jumping. Additional experimental work was planned, but before the season was over, the men were actually making jumps to fires in inaccessible territory and promptly controlling them.

The "smokejumpers" wore specially designed helmets, masks, and protective clothing. Each carried a rope to let himself down if his parachute lodged in a tree. A special type of parachute was developed, designed for slow descent with minimum oscillation, and equipped with steering slots that enabled a jumper to land within a few yards of his goal. After a man jumped, his fire-fighting pack, containing tools, rations, water canteen, first-aid kit, etc., was parachuted to him. Military staff officers visited the smokejumper training camp in 1940, and many of the Forest Service ideas and techniques were later employed in organizing the first Army paratroop training at Fort Benning, Ga.

Since 1940, smokejumper operations have been conducted by the Forest Service every year in certain sections of the West. The men

are carefully selected and thoroughly trained before the beginning of each fire season. By the use of smokejumper crews, fires in remote areas can be attacked soon after discovery, whereas ground crews would require many hours to reach them. Hundreds of fires have been quickly controlled by the parachuting fire fighters, whereas otherwise they would have spread to large size and caused great damage.

Last year, the Forest Service smokejumper corps numbered 251 men. Crews were assigned to the national forests of Montana, Idaho, and Oregon. A small crew also was assigned to New Mexico early in the season. Crews jumped to a total of 158 fires for initial attack or follow-up. The estimated net savings in suppression costs resulting from the use of smokejumpers was \$257,000. In the first 10 years of smokejumper operations (1940-49) the men jumped to a total of 1,424 fires. Estimated savings amounted to more than \$2,000,000.

The Forest Service has worked continually on the improvement of existing equipment and the development of new equipment to increase the efficiency and safety of aerial fire control operations. Parachutes and parachute packing methods used for dropping fire-fighting equipment and supplies have been improved to reduce opening and landing shock, reduce oscillation, and prevent parachutes and cargo from damaging or catching on the tail surfaces of aircraft. A special parachute-cargo carrier and discharging device has now been developed to permit safe parachuting of supplies from light airplanes manned only with a pilot. This will make possible a reduction in the cost of servicing isolated small fire-fighting crews and lookout stations. Steerable parachutes used by smokejumpers have been improved to increase their forward speed. This permits landing under more adverse wind conditions.

Helicopters

In 1945, the Army and the Forest Service joined in a series of tests with helicopters under western forest conditions. These and the tests of commercial helicopters that followed proved the value of this type of aircraft in forest-fire control work. With its ability to maneuver, fly at slow speeds, and hover, it can enable observers to note the behavior of a fire and the type of ground cover in detail, and so rapidly make accurate organizational plans to combat the fire. Helicopters can be used to transport key men to a fire quickly, to deliver men to fires in isolated areas or directly to the weak sectors of a dangerous fire; also to return men from fires, thus making them more quickly available for other duties.

In 1950, use of helicopters when available was adopted as part of the regular operational procedure. Contract arrangements were made for the use of currently available helicopters when and as needed. The high cost and the relatively small payload of the helicopter are present limiting factors in their use. Many outstanding new developments in this type of aircraft are in progress, and when these become available for civilian use, further experiments will be conducted to determine the limits of safe operation of helicopters and their best application in forest-fire control.

Mechanized Equipment

Ground work in fire suppression is becoming increasingly mechanized. The Forest Service and State forestry departments are con-

stantly working to improve their equipment and develop new items that will increase the speed and effectiveness of fire control. Regional fire-equipment development committees representing State and Federal agencies help to reduce duplication of effort in testing and experiments. Equipment boards within the Forest Service also aid in coordinating effort.

Among recent developments by the Forest Service is a combination tool box and pumper-tanker for 1½- to 1-ton pickup trucks. These combination units serve during the fire season for fire-suppression work, and in off-season, with pumper and hose reel removed, they can be used as a tool and supply box for other work. Much progress also has been made in standardizing forest-fire tanker equipment.

Performance testing of tractor-drawn, fire-line plows is screening the hundreds of different plow designs, proving the best, and aiding in standardization. As a result of the tests, manufacturers are showing increased interest in producing this specialized equipment.

About two-thirds of the cost of forest-fire suppression is for labor; many man-hours of hard, sweating work with hand tools are necessary on most fires because much fire line, especially in rough country, cannot be worked with tractor-dozers or other heavy mechanical equipment. Hence great need exists for small-sized power tools for fire fighters. In the same way that gasoline-powered chain saws have reduced the labor required for tree-felling, small fire-line trenching machines and brush and sapling cutters can aid in fire suppression. The Forest Service has made progress in developing a suitable motor fire-line trencher, and this machine is scheduled to be placed in field service in 1952. Commercial manufacturers are cooperating with the Forest Service in the development of gasoline-engine-powered brush and sapling cutters for forest-fire suppression work.

The Forest Service has special camp equipment for feeding, "sleeping," and caring for fire fighters. During a fire emergency, temporary camps must be set up quickly for dozens, and sometimes hundreds or thousands, of men. Compact camp cooking and other outfits designed for 10-man, 25-man, etc., camps, are kept ready-packed to go out on a moment's notice. The fire-camp equipment is constantly being modernized and made more efficient. Disposable paper and plastic dishes and utensils are now replacing tinware. Camp kitchen crews and equipment needs are being reduced through use of pre-cooked or frozen foods, or delivery (sometimes by air) of ready-to-eat hot meals. Disposable paper sleeping bags, developed in cooperation with the paper industry, save a large part of the costs of cleaning blankets and kapok sleeping bags. Combination unit-packaging of food and mess equipment and its delivery to the fire line by parachute or helicopter reduces the time consumed by fire fighters traveling between fire line and camp.

Communications

Speedy and reliable communications are one of the keys to successful forest-fire suppression. Both telephone and radio systems have a part in the communications networks on the national forests. Primary fire-detection stations are usually connected with headquarters stations by telephone lines. Portable, mobile, and field radios are used by "smokechasers," and for quickly setting up communications on going fires. As commercial telephone and power lines extend farther out

into the forest areas, the Forest Service is constantly altering and modifying its communication systems on the national forests. More radio stations and portable field radios are being acquired each year, in the process of gradually building up the radio communications system to its planned level.

Last year the development of a full line of equipment types for use in a higher radio-frequency band was completed, and more channels will now be available for forestry communications. It will probably take five additional years to replace all the old prewar radio systems and complete the new networks needed in fire-protection areas that still lack radio communication.

Several State forestry agencies also have long been active in developing radio communication networks, and during the past few years the use of mobile and portable radio by other States has rapidly increased. The Forest Service, through its radio laboratory and regional communications officers, is continuing to provide assistance to the States in planning their communications programs. Also, special equipment is being installed in several States for intertying State and Federal forest radio networks, to provide for interchanging fire-control information.

Forest-Fire Research

From the start, progress in all phases of fire control has depended on advances in understanding the behavior of fire in the many varied situations throughout the country, and on discovering new and better ways to keep fires from starting and to fight them skillfully when they do start. Systematic fire control has been built on the results of fundamental and applied research and equipment development over the years. Studies on problems in fire control were among the earliest research projects undertaken by the forest experiment stations. From the earliest days of the Forest Service, too, nearly every man engaged in fire-control work has studied fires and tried new methods, because the problems were challenging, and because administrators have taken the lead in solving them. Consequently, a constant flow of new ideas and rapid development of new and more efficient methods comes from both research and administrative men. Much of their earlier work, however, was by trial-and-error methods, and there was need for more correlation and systematization of research and equipment development activities.

Forest Service activities looking to the development of new or improved fire-control equipment are now directed mainly by the Service's Division of Fire Control which maintains two equipment-development centers, assigns equipment-development projects to engineers and other technicians in the various national-forest regions, works with various manufacturers, and serves as a clearing house for the interchange of information on equipment matters among fire-control agencies. Many of the equipment-development projects are conducted in cooperation with State forestry agencies.

In addition to this on-the-job development work the Forest Service conducts a program of scientific study, through the regional forest experiment stations, on the more basic problems of forest-fire control. To better correlate the fire-research activities under way and to develop a more effective program of research for the future, the Forest Service set up a new Division of Fire Research in 1949. Under the direction

of this Division, studies are under way on the behavior of fires, on improved methods for measuring fire danger, on the visibility factors that affect fire detection both from the air and from the ground, and on numerous other problems that concern the fire administrators and fire fighters on the job. Certain beneficial uses of fire in the forests are being explored. There is a modest program of more fundamental research also, which is concerned with the study of fire itself.

Fire-research activities during the past year included further laboratory and field studies of the advantages and limitations of wetting agents in forest-fire fighting. Three regular fire-fighting crews were equipped with facilities for using both plain water and wetting-agent solutions for comparative trials throughout the 1951 fire season.

New evidence was developed during the year on the relation of local turbulence of the atmosphere to the rate of burning and direction of spread of forest fires. This may point the way eventually to methods of recognizing "blow-up" conditions in advance, which would make possible more skillful fire-fighting strategy. It could save many forest-fire fighters' lives.

The Forest Service in 1951 published a training manual entitled "Water versus Fire," which was prepared by the Service's fire specialists in California. This publication brought together the "know-how" of experienced fire-control officers, pump mechanics, and fire-research specialists in a nontechnical form for effective training of crews in the handling of pumps, hose, and related equipment. The manual is being widely used by Federal, State, and private forest-protection agencies. It also met an immediate need in civilian defense; the Federal Civil Defense Administration planned to distribute it to local defense organizations throughout the United States. Demands for the manual have reached a half million copies.

Cooperative Fire Prevention Campaigns

Since 1942, a Nation-wide campaign has been conducted each year to obtain greater public cooperation in the prevention of forest fires. It is now known as the Cooperative Forest Fire Prevention Campaign, officially sponsored by the State Foresters of 43 States and the United States Forest Service. This campaign has continued each year with the active support of the advertising industry, through its Advertising Council, Inc., and the cooperation of many other organizations and individuals. The Post Office Department and other Federal agencies have helped greatly in displaying fire-prevention posters to the public. The American Red Cross, Boy Scouts, Girl Scouts, and thousands of school teachers are strong supporters. Last year, American business, through the Advertising Council, contributed between 5 and 6 million dollars in free advertising space, time, and talent. This represented the support of advertisers, agencies, newspapers, radio, television, and transportation advertising.

A 1945 campaign poster showed a bear dousing a campfire with a bucket of water. "Smokey," as the bear was called, seemed to catch the public fancy, and since 1947 each year's campaign poster has featured the fire-prevention bear. In 1950, a bear cub, rescued from a forest fire in New Mexico, was named after the fire prevention posters' Smokey, and his story was carried in newspapers and on radio and television from coast to coast.

Localized campaigns conducted by various groups, and the extensive and growing fire-prevention efforts carried on directly by State forestry agencies supplement the Nation-wide campaign. "Keep Green" programs sponsored by the forest-products industries have been organized in nearly 30 States, and provide for educational and publicity efforts on a State-wide basis.

Certainly as a result of these educational efforts, the American public has seen and heard more about forest-fire prevention than ever before. Just how many fires have been prevented by these campaigns is impossible to determine. Undoubtedly, however, they were responsible in no small measure for the fact that the number of fires averaged over 15,000 a year less during the 5-year period 1946-50 than in the years before World War II. This reduction has occurred in spite of increases in registrations in national forests and parks, in sale of hunting and fishing licenses, in motor travel, and in other factors which indicate that public use of forests and outdoor areas was some 40 percent greater than it was 10 years ago.

Fire Protection in Civil Defense

At the request of the Federal Civil Defense Administration, the Forest Service and cooperating agencies early in 1951 began the preparation and assembly of comprehensive plans for protection of all the Nation's forest and wild lands from fire, including possible fire attacks through enemy action. The Department of the Interior and the State Foresters cooperated in the preparation of the operational fire plans. These plans, all told, cover more than a billion acres of forest and range land in the United States and Alaska.

A national committee was set up to coordinate the emergency fire-protection program, with C. A. Gustafson, Chief of the Forest Service's Division of Fire Control, as chairman. Other members of the committee are Joseph Kaylor, of Maryland, representing the State Foresters' Association; John F. Shanklin, of the Bureau of Land Management, Department of the Interior; and Howard J. Eberly, representing the Federal-State cooperative forest fire protection program.

The program calls for planning and organization of forest-fire fighting forces to meet extraordinary situations that might arise in the event of a war emergency. Master Wild Land Operational Fire Plans have been developed for 43 States, providing for the quick mobilization of all presently available fire-fighting personnel and equipment when needed, and for the additional personnel, equipment, and facilitating gear that might be required to prevent a fire disaster or calamity from developing.

During World War II, the enemy was well aware of the damage that forest fires could do to our war effort. Early in the war, an alert Forest Service lookout man stopped a forest fire started by an enemy incendiary bomb dropped by an airplane presumably launched from a Japanese submarine off the coast of Oregon. Later, in 1945, the Japanese made a long-distance attack on the forests of the western United States with incendiary balloons. Besides the direct damage forest fires do to timber, watersheds, and property—and to human life—they can disrupt communications and transportation, tie up logging and other industrial operations, and cause a big drain on the time

of workers on the farms and in the factories—time that would be much better spent at productive work, whether during a war emergency or in time of peace.

Forest Fire Losses Can Be Stopped

Significant progress has been made, especially during the past 20 years, in the development of effective fire-control techniques, and in extending organized protection to forest lands. Wherever systematic, organized fire control has been undertaken, a pronounced decrease in forest-fire losses has resulted.

With adequate forces and facilities and the use of modern techniques, forest-fire losses can be reduced to a point where they no longer are a serious hazard to timber-growing enterprises or to watershed values.

FOREST PEST CONTROL

Fire is not the only "natural enemy" of the forests. Nor, in terms of current damage to timber, is it the worst. Insects and diseases that attack forest trees cause a greater loss of merchantable timber in the United States each year than does fire. The story of forest-fire protection in the United States is one of substantial progress. During the past half century we have extended systematic protection to a major portion of our forest lands, and we have accomplished a great reduction in losses wherever such protection has been applied. With insects and diseases no such reduction of losses can be reported. We have made significant advances in knowledge of these pests and in control techniques. But meanwhile the damage caused by forest insects and diseases has increased.

According to forest reappraisal estimates, the average annual drain from fire during the decade 1934-43 was 460 million cubic feet. The estimated timber loss from insects and diseases during the same period was 622 million cubic feet each year.

This estimated loss caused by insects and diseases represented only the more obvious losses, mainly those occurring as a result of epidemic outbreak. It covered only commercial timber volume, and took no account of the growth potential, nor of species value. It did not cover damage to watersheds, nor increased fire danger. And even in the case of commercial timber, the total loss would be vastly greater if it were possible to measure the damage caused by the normal activity of a myriad of insect and wood-destroying pests ever present in the forests.

Many thousands of different kinds of insects, fungi, bacteria, and other pests and parasites affect the forests. Some of these are beneficial, as the insects that aid pollination, or the fungi and bacteria that help reduce dead wood and leaves to humus. But many are destructive; they may deform trees, slow their growth, or cause their death. In epidemic outbreaks, they can demolish vast stands of timber.

A certain degree of natural balance obtains between the trees and their native insects and disease pests. But the so-called balance of nature is never an exact balance at any moment; it is an averaging out over long periods of time. Meanwhile the trees of one or another species may be all but wiped out over a wide area by insects or disease, and then may or may not regenerate in that area after the epidemic has run its course. In various parts of the country, evidences can be

found that forest pests in earlier times have run their course in uncontrolled, devastating epidemics.

The natural balance has been affected, too, by the activities of man—by his timber cutting and clearing of land, by his causing woods fires, by his transplanting of species from one region to another and introduction of exotic species from foreign lands. He has allowed foreign insects and diseases to enter this country too, and some of these, such as the chestnut blight, the Dutch elm disease, the Japanese beetle, and gypsy moth, have become especially virulent and destructive in their new environment.

Insect Enemies of Trees

Insects may affect forest trees at any time during the trees' life cycle. Certain pine cone beetles, for example, at times destroy nearly 100 percent of the seed crop of some of the western pines. When this occurs, practically all tree regeneration of the affected species is prevented. This will affect the character of the timber stand many years later. Other insects, such as white grubs, may cut off the roots of nursery stock and of newly established tree seedlings, and this again will alter the proportion of a particular tree species in a future stand. The pine reproduction weevil and the pales weevil often destroy large numbers of recently planted trees. During the sapling stage of a timber stand, various insects do damage in varying degrees. The white pine weevil, for example, attacks sapling-size white pines in the Northeast, especially in plantations and in young stands seeded in old fields or clearings. This weevil's attacks in the sapling stage causes crooked growth, and so may greatly reduce the final value of the mature timber stand. Some insects, such as the bark beetles, generally attack mature trees or overmature trees weakened by old age. Others, such as the spruce budworm, attack trees of all ages. Bark beetles and spruce budworms are among the worst killers of trees.

The insect enemies of trees also have their own natural enemies. Birds consume large numbers of insects and help to hold them in check. Frequently local outbreaks of bark beetles are completely checked by woodpeckers. Moles, shrews, chipmunks, and other small mammals likewise have an important role in the destruction of forest insects, especially those hibernating or spending their grub stage in the soil. Insects are subject to diseases caused by bacteria, fungi, viruses, and other organisms. And there are many beneficial insects that prey upon the harmful species. The beneficial insects include parasitic wasps and flies which deposit their eggs on or in the body of another insect and whose larvae feed on the body of the host. Other insects, such as lacewing flies, the praying mantis, and certain kinds of beetles and ants, are predators that devour large numbers of forest insects.

Extreme changes of winter temperature in a short time may wipe out vast numbers of insects. On the other hand, extended droughts may make trees more readily susceptible to attack, or windfalls may create conditions favorable for insect population increases. Trees weakened by fire are especially attractive to certain insects, and forest fires are sometimes followed by insect outbreaks. Conversely, the dead trees left after an insect epidemic may make a greatly increased fire hazard. A fire in a tangled mass of fallen dead trees burns fiercely

and is almost impossible to stop. Even the snags of occasional insect-killed trees scattered through a green forest add greatly to the difficulty of fire control.

Normally, climatic changes, natural enemies, and other factors tend to hold the populations of most injurious insects more or less in check. The aggregate damage caused by these injurious insects is enormous, but the annual growth in the forest as a whole is sufficient to offset it, or to produce a net accretion of timber.

Under certain conditions, however, some kinds of injurious insects may build up in excessive numbers. A particular species may, during one period, be very rare. Yet within a short time it will be found by the millions within a small area.

When such epidemic infestations of destructive forest insects occur or are threatened, immediate and drastic control measures are necessary if huge losses are to be avoided.

Bark Beetles

Old-time foresters used to chant a bit of verse about "the bug called *Dendroctonus*" who lived in the bark of the pine, and was harder to kill than a lion. This referred, in imperfect rhyme but with much feeling, to the bark beetles of the genus *Dendroctonus*. Bark beetles are among the most destructive forest insects from the standpoint of commercial timber values affected. The larvae of these beetles feed under the bark of a tree, next to the wood. In sufficient numbers, they can kill the tree in a single season. The bark beetles are represented by a number of species. They generally attack the large, mature trees—trees that contain merchantable timber.

It is characteristic of bark-beetle infestations that they can quickly flare up into devastating epidemics. An epidemic of the Black Hills beetle (*Dendroctonus ponderosae* Hopk.), that ran from 1895 to 1908, killed practically all the mature pine on more than 100,000 acres in the Black Hills of South Dakota. The same species of bark beetle, in a rapidly spreading infestation in northern Arizona from 1917 to 1926 killed an estimated 12 percent of the entire stand on the Kaibab Plateau. In Idaho and Montana, foresters still have to cope with a greatly increased fire hazard caused by the ravages of bark beetles in lodgepole pine stands over millions of acres in the early 1920's. In recent epidemics in the Western States, bark beetles are estimated to have killed some 45 billion board feet of pine timber.

It is this type of insect, specifically the Engelmann spruce bark beetle (*Dendroctonus engelmanni* Hopk.), that is currently causing great damage to timber stands in western Colorado, and is threatening all the Engelmann spruce stands in that State and the adjoining portions of neighboring States. In the past 10 years, these insects have killed more than 4 billion board feet of timber, an amount equal to the lumber for 400,000 five-room houses. They have killed 16 times more timber than was destroyed by fire in the past 30 years in the entire Rocky Mountain region. They left gray ghost forests of dead trees over wide areas.

New, effective control methods, recently developed by the Bureau of Entomology and Plant Quarantine, have made feasible a control program to prevent the spread of this vast infestation to other areas of green timber. Control operations against the Engelmann spruce

beetle were started by the Forest Service on the White River, Routt, and Arapaho National Forests in June 1950, with emergency funds made available by Congress. Spraying continued through the summer until fall snows closed the work camps. More than 784,000 individual trees were treated. In 1951, the Forest Service was unable to resume control operations until late in the year when a regular appropriation for the work became available.

Very great values in watershed protection and in scenic and recreational resources are threatened by the beetle epidemic in Colorado. The destructive infestation can be controlled. To fail to do so would invite losses and damage that would be permanently detrimental to the welfare of a large region.

The most destructive bark beetle in the East is the southern pine beetle (*Dendroctonus frontalis* Zimm.). It attacks nearly all species of pine from Pennsylvania south to the Gulf of Mexico and west to the Ozarks. Rather frequent local outbreaks of this insect throughout the South have killed large quantities of timber.

Defoliators

The defoliators, as an insect group, rank with the bark beetles as destroyers. They include such destructive insects as the tussock moth, larch sawfly, spruce budworm, tent caterpillar, and the imported gypsy moth and Japanese beetle. These weaken or kill trees by eating their foliage. Generally trees of all ages are affected.

Prevalent over extensive acreages in the Pacific Northwest is the spruce budworm (*Choristoneura fumiferana* Clem.), which is defoliating Douglas-fir and white fir, and causing much loss of tree growth and the death of many trees. Positive control of this insect is being accomplished, however, in a cooperative program that so far has covered well over a million acres.

The spruce budworm also is a destructive pest in the Northeast. In an epidemic lasting from about 1910 to 1920 that ravaged the spruce and fir forests of northern New England, eastern Canada, and Minnesota, it was estimated that the equivalent of more than 25 years' supply of pulpwood for current annual American paper requirements was lost. Epidemic outbreaks of the spruce budworm have again occurred over large areas in Canada in recent years, and smaller outbreaks took place in New England and the Adirondack region of New York.

Borers and Other Bugs

The many kinds of "bugs" that attack forest trees include aphids and scales that suck the juices from foliage or twigs and thus weaken trees and slow their growth. Other insects lay eggs in the flowers, fruit, or seeds of trees. When the larvae hatch, the damage caused by their feeding may prevent the tree from producing seed. Certain flies, moths, beetles, and wasps cause the growth of galls when they deposit their eggs in the living tissues of the stems, leaves, or fruits of trees. The familiar "oak apple" is an example of an insect-caused gall.

Woodborers and other insects often cause injuries to living trees which show up as defects in the lumber and thus reduce its value. Woodborers and termites also cause great damage to felled timber, lumber, poles, posts, and wood in buildings. The grade of lumber cut from logs may be lowered by the borings of worm-hole or pin-hole

borers in the green logs. Nearly everyone is familiar with the work of powder-post beetles in furniture, floors, and tool handles. Tremendous damage to building foundations, fence posts, telephone poles, and wood in many other uses is caused by various species of termites.

Control Methods Improve

Revolutionary improvements in forest insect control techniques have occurred during the past 10 years. This has come about not only through the discovery of potent new insecticides but also through development of better facilities for applying these insecticides.

Not long ago, the only method for controlling bark beetles was to fell every infested tree, strip the bark from it and burn it. Now beetle infestation can be controlled in most stands by treating the standing trees with an insecticide. Orthodichlorobenzene, mixed with fuel oil, is used. The insecticide penetrates the bark to inner recesses and its fumigating effect kills the beetle larvae. This method was used successfully in bringing under control a recent epidemic of mountain pine beetle in lodgepole pine in the Targhee and Teton National Forests of Idaho and Wyoming. It was successful, too, in controlling a 1949-50 outbreak of Black Hills beetle in the Harney and Black Hills National Forests in South Dakota.

Another new insecticide, ethylene dibromide, is being tested against bark beetles. It has advantages over orthodichlorobenzene: It is less bulky to handle, and water can be used as the diluent instead of oil. Tests in the use of this material for a variety of species and under a variety of conditions are being continued under direction of the Bureau of Entomology and Plant Quarantine.

Aerial spraying is ineffective against bark beetles because the mist sprays from the air will not reach the beetle larvae under the bark of the trees. Bark beetles therefore must be attacked with forceful sprays from the ground, and treatment so far is still on a tree-by-tree basis.

Airplane spraying is feasible, however, against defoliators such as the spruce budworm and the Great Basin tent caterpillar. These can now be controlled through the use of DDT dissolved in hydrocarbons (fuel oil and such). At the strength used ($\frac{1}{2}$ to 1 pound per acre) the DDT apparently causes no serious damage to birds and mammals in the forest.

The first large-scale use of airplanes for DDT spraying over a western forested mountain area was in a 1947 operation against the tussock moth in northern Idaho. This was the most violent outbreak of Douglas-fir tussock moth (*Hemerocampa pseudotsugata* McD.) ever discovered. It threatened millions of dollars worth of grand fir and Douglas-fir timber. The epidemic was completely controlled by an airplane spraying project covering 413,500 acres and involving 2,120 individual flights to distribute 391,000 gallons of insecticide. The Bureau of Entomology and Plant Quarantine, Forest Service, State of Idaho, and private landowners cooperated in the project.

Aerial application of insecticide is also successfully controlling infestations of the spruce budworm in Oregon and Washington. Some 250,000 acres of Douglas-fir forest in western Oregon were sprayed in 1949. Another huge aerial spraying job, covering some 966,000 acres in 1950 and 940,000 acres in 1951, was conducted in eastern Oregon and Washington.

In 1949 the Massachusetts Department of Conservation directed a project for the aerial spraying of 229,000 acres of woodlands on Cape Cod to control the gypsy moth. The Federal Government, State, county, and towns cooperated in the enterprise.

Work at the Forest Products Laboratory and by State and private agencies has developed chemical treatments and improved drying, storage, and construction practices that make possible the prevention of much damage to wood from wood borers and termites, and from stain and decay. Continued research will produce even better and more economical methods to protect wood from such pests, and thus help to extend our national timber supply, and further increase the utility of wood.

Beneficial Effects of Silviculture

Good forest management will help to prevent the build-up of many kinds of injurious insect pests. Vigorous rapid-growing trees are apt to be less susceptible to attack by bark beetles and defoliators than slow-growing mature trees or trees weakened by crowding or other unfavorable growing conditions. Removal of overmature timber, thinning young stands to maintain rapid growth, and disposal of logging slash which may be a breeding ground for some insects, are measures that help to prevent conditions favorable to the increase of insect populations.

Special silvicultural practices that aid insect control are being worked out through research. The Northeastern Forest Experiment Station and the New Haven Station of BEPQ have made studies looking toward improving methods of cutting in northern coniferous forests as a means of controlling spruce budworm. Overmature and decadent balsam fir is especially vulnerable to attacks by this insect. Removal of these trees from spruce-fir stands not only reduces the likelihood of severe attack but promotes more vigorous growth of the younger, better trees in the forest.

F. P. Keen, of the Bureau of Entomology and Plant Quarantine, working in cooperation with the California Forest and Range Experiment Station, has conducted studies which recognize the beneficial results that accrue through silvicultural practices. Logging which usually removes the old and stagnant trees tends to prevent a build-up of the ponderosa pine beetle (*Dendroctonus brevicornis* Lec.) to the degree that fosters epidemics. Harvesting of ponderosa pine timber from the national forests where this insect is prevalent is based on the Keen finding that susceptibility to bark beetle attack is directly related to the health of the tree as indicated by the length, color, and density of needles and dying twigs. The Keen studies have provided an index of growth vigor which makes it possible to log selectively the most susceptible trees and thus reduce the danger of beetle infestations.

Diseases of Trees

Like mankind, the trees of the forest are subject to many ills. The diseases that threaten trees frequently are highly contagious. They may be caused by bacteria or fungi, by viruses, or by microscopic nematodes or eel worms. There are parasitic plants, too, such as mistletoes and dodders, that damage trees.

Various fungi and bacteria produce leaf spots, rusts, wilts, and blights that cause defoliation and so weaken trees. Others cause cankers, galls, or root diseases that likewise slow the growth of trees, or kill them. The decay fungi cause deterioration of wood in standing trees in the forest and reduce its value for use as lumber, posts, poles, in buildings, and for other purposes.

Trees weakened by fungi often are more susceptible to attack by insects. And insect-damaged trees, conversely, may be more subject to disease. Most of the virus diseases, and some of the stain and decay fungi, are spread by insects. Fire wounds on trees are entering places for decay fungi.

Under natural conditions the injuries caused by disease, like those caused by insects, are offset in time by new growth, and the forest survives. But the natural balance is achieved only with tremendous losses. These losses for the most part are inconspicuous; they result from the weakening of trees and slowing of growth, and from the deterioration of wood by stains, molds, and decay. It has been estimated that the heart rot fungi alone cause an annual saw-timber loss of 1½ billion board feet in the forests of the United States.

There are some destructive new diseases introduced by man, as well as certain old diseases that have become epidemic as a result of man's activities. These are major threats; they are capable of wiping out whole species of trees. The chestnut blight, a fungus disease brought to this country from Asia around the turn of the century, has practically done so. The American chestnut was once one of the most important commercial forest trees of the eastern United States. In a few decades, the disease destroyed all commercial growth of native chestnut throughout its range. White pine blister rust, another introduced fungus disease, is capable, unless controlled, of killing out the valuable white pines of both the Eastern and Western States. The American elm, more valuable as a shade tree than as a forest tree, is threatened by the Dutch elm disease, brought in from Europe. Phloem necrosis, a virus disease, presumed to be native, also is killing many elm trees in the Midwest. Oak wilt is a major threat to all eastern species of oak.

White Pine Blister Rust

Because of its threat to valuable commercial timber, the white pine blister rust is one of the most serious forest tree diseases in the United States. The blister rust attacks and destroys white, or five-needled, pines. Among the native five-needled pines are three of our leading timber species: The eastern white pine of the Eastern and Lake States; the western white pine which is a leading timber tree of the northern Rocky Mountain region; and the valuable sugar pine of California and Oregon. The timber of these three species, as it stands today in the forests, is worth hundreds of millions of dollars. It is the raw material of numerous mills and manufacturing industries employing thousands of workers and forming the economic basis of many communities.

These three valuable species, along with other five-needle pine species of lesser value, are endangered by a fungus disease brought to this country from Europe. Blister rust was first discovered in New York State in 1906. By 1915 it had spread widely among native

white pines in the Northeast. In 1921 the disease was found in the Pacific Northwest.

The blister rust fungus spends a part of its life cycle on an alternate host—various kinds of currants and gooseberries, plants of the genus *Ribes*. The fungus does not spread directly from pine to pine; it can spread only from ribes plants. Control is possible, therefore, by eradication of ribes in the vicinity of white pines.

Control operations were started by the Department of Agriculture in cooperation with the Northeastern States in 1922. They were extended to the Lake States, the southern Appalachians, and the northern Rocky Mountain and Pacific Coast States as these regions were invaded by the disease. The Bureau of Entomology and Plant Quarantine has been assigned responsibility for general leadership, coordination, and technical direction of the control program, and for control operations on State and private lands. The Forest Service is responsible for control operations on national-forest lands, as are other Federal agencies on lands under their jurisdiction. Control operations on State and private lands are financed jointly with Federal and State funds, supplemented by county, township, and private owner contributions of funds or services. White pine stands in 32 States are being protected against the disease.

Eradication of wild currants and gooseberries from white-pine areas is mainly a job of hand-pulling or grubbing with hand tools. In some locations, chemicals or mechanical equipment can be used to speed up the work of destroying these bushes. Fire protection and forest management that keeps the stands of trees dense and vigorous helps to suppress the growth of wild ribes.

The blister rust control area in the United States totals about 26 million acres of selected lands in which white pine is of such major importance as to make control work economically justifiable. On some 14 million acres, or 55 percent of the area, the disease is now under control, and only a low-cost program of maintenance will be needed to keep this land safe for the production of white pine. Most of this acreage is in the Eastern and Lake States. An additional 9 million acres has received partial protection. Follow-up work, properly timed, will be needed to make this area safe. Almost 3 million acres still need to be worked over for the initial removal of ribes. In some parts of this unworked area most of the pines already are fatally infected. First priority must be given, however, to follow-up work on the 9 million acres partially protected, so that the benefit of this work will not be lost.

Even when control is effected throughout the designated control area, we shall still be surrendering to the disease a vast amount of valuable white pine timber growth in scattered and mixed stands.

Oak Wilt

Oak wilt is a fungus disease that is causing much concern, because of its rapid spread in the Midwestern States during the past few years. In 1951 the disease was found in seven more States—Michigan, Maryland, West Virginia, Virginia, North Carolina, Tennessee, and Kentucky.

The disease attacks all species of oak native to these States, but it develops most rapidly on red and black oaks. The fungus grows in the sapwood of the tree, and many infected trees soon die. The

agent that spreads the disease has not yet been discovered. It is known that local spreading takes place through natural root grafts between neighboring trees, but this does not account for the long jumps indicated by the newly discovered points of infection.

So far, there has been no indication that oak wilt is developing the momentum that characterized the spread of the chestnut blight. It is hoped that research by the Department of Agriculture and State agencies will develop an effective method of control.

Brown Spot and Little Leaf

Longleaf pine in the South is highly susceptible to a disease called brown spot needle blight which is present in varying degrees over the entire southern pine belt. The disease is caused by a fungus which attacks small pine seedlings, retarding their growth. Successive defoliations may eventually kill many of them. Successful regeneration or reforestation of longleaf pine is often seriously hampered by the presence of the disease.

Infections of brown spot can be checked by the use of fire. Carefully controlled burning of infected plantations or areas of natural reproduction is now being practiced to control the disease in grass-stage seedlings. Many acres of young longleaf pine that were treated in time now have healthy, well-stocked stands of sapling trees.

Longleaf pine is one of the most important forest trees of the South. It makes up a large proportion of the total annual lumber cut of southern pine; it furnishes some 40 percent of the naval stores production; and it is well adapted for paper pulp.

Another menace to southern pine timber growing is the little leaf disease. This disease occurs in the Piedmont region from Virginia to Alabama and northern Mississippi. It affects mainly the short-leaf pine, another of the South's important timber trees. Affected trees show shortened and yellowish foliage; the tree's growth is slowed, and after a few years many trees die. The cause of the disease has not yet been determined. It may be a root fungus, a virus, or lack of some element in the soil. Heaviest losses are usually in trees between the ages of 30 and 50 years. Demand for pine for pulpwood makes possible the profitable salvage and marketing of trees of this age when little leaf disease appears.

Pole Blight

In the northern Rocky Mountain Region, foresters have become increasingly alarmed about a recently discovered disease called pole blight, affecting western white pine. The disease was first observed in northern Idaho in the 1930's. It attacks pole-size trees; affected trees die in from 1 to 10 years. The disease already has damaged western white pine stands on thousands of acres. Some small areas already show a 100-percent kill of white pine.

Western white pine of the pole-size age class is scarce in the northern Rockies. If the pole blight should wipe out a large portion of the stands of this age class, continuity of production will be disrupted. The disease would seriously hamper efforts to perpetuate western white pine and the industries and local economies dependent upon it.

The cause of pole blight is unknown. Intensive research is under way to determine what causes this disease and whether or not it can be controlled.

Dwarf Mistletoes

Dwarf mistletoes are serious pests of western coniferous forests. These are parasitic plants, related to the familiar Christmas mistletoes, that grow on the branches and stems of the trees. They slow the growth rate of infested trees and cause much loss from degrade or cull in logs. Infested trees are subject to attack by insects and fungi, and the mistletoe itself kills many trees. Various species of dwarf mistletoe attack most kinds of coniferous trees in the West. One species is found in the Eastern and Lake States, mainly on spruce. The pest does not occur in the pine forests of the Southeast nor in the Douglas-fir region of Oregon and Washington. But it is reported to be the greatest single cause of loss in ponderosa pine in the Southwest.

When the seeds of dwarf mistletoe ripen, the seed casings rupture and the seeds are shot out with explosive force. They may travel as much as 60 feet. The seeds are sticky, and those that strike branches of other trees or other branches of the same tree may adhere and start new plants. Once the parasite is established on a single tree, therefore, it tends to spread slowly but steadily to other trees in the forest.

Mistletoe can be controlled by pruning it out, and this may be a practicable and worth-while measure when infestations are found in their early stages. In managed forests, mistletoed trees can be marked for cutting at the time merchantable trees are being logged, or they can be eliminated in thinning and weeding operations in young stands. Continued research should lead to more effective silvicultural practices for checking the parasite as well as to practicable methods for direct control.

Wind and Weather

Like man again, the trees of the forest may suffer from diseases caused by nutritional deficiencies or excesses—and the trees cannot individually control their diet, as human beings can. Fertilization and other soil-building measures that are used with orchard and shade trees are not ordinarily practicable under forest conditions. As the practice of forestry becomes more intensive, however, certain soil-improvement measures may become feasible. Much more research is needed on the relation of forest soils to tree growth and pest control.

Nonparasitic diseases of forest trees also may be caused by drought or too much water, or by sunscald or winter injury. Smoke and gases from industrial plants sometimes injure or kill trees. Devastating damage was done to trees in the Ducktown basin in southeastern Tennessee, for example, by tree-killing fumes from a copper smelter.

Wind and weather can cause tremendous damage. The great hurricane that swept into New England on September 21, 1938, left wind-thrown timber, in large and small bodies, over some 15,000,000 acres. Fifty-one counties in the six New England States were affected. The greatest timber damage occurred in Massachusetts and New Hampshire. On some 600,000 acres the mature trees were almost completely felled.

The volume of timber blown down was estimated to be 2,650,000,000 board feet. Some 1,600,000,000 board feet was finally salvaged, largely through an emergency timber salvage program administered by the Forest Service, acting as agent for the Federal Surplus Commodities

Corporation and the Disaster Loan Corporation. There was an inestimable amount of damaged young growth which had no immediate salvage value, but which constituted the potential raw material for much future forest industry operation in New England.

In January 1944 a severe ice storm in east Texas caused great damage to the forests. Millions of trees were broken or knocked down by the wind and the weight of the ice that formed on their branches. About 400,000 acres contained stands of timber of sufficient density to justify salvage operations, and another emergency timber salvage program was organized.

In November 1950 a terrific hurricane caused unprecedented devastation on both private and public forest lands in the Adirondack region of New York. About 425,000 acres of forest land suffered wind damage, which in some places meant that 100 percent of the standing timber was down.

Mississippi's forests suffered severely in February 1951, when an ice storm covered some 16 million acres of the State. Wood-using industries, woodland owners, and State and Federal foresters were working to utilize as much of the salvageable timber as possible before it deteriorated too badly.

Wind and weather damage often creates conditions favorable for epidemic buildups of forest insect and disease pests. Windthrown trees from a 1939 windstorm were the breeding ground for the destructive epidemic of Engelmann spruce bark beetles in Colorado. The work of insects and rot fungi usually causes rapid deterioration of windthrown or storm-damaged timber; hence, prompt salvage operations are necessary if the wood is to be saved while it is still usable.

Research is developing ways to minimize windstorm damage to timber stands through forest-management practices. Reducing the danger of windthrow is a consideration, for example, in the strip or patch cutting systems used in mature timber stands in some sections of the Northwest. The residual stands, left in dense blocks or strips, are less subject to windthrow than when scattered trees are left.

The Forest Pest Control Act

Of necessity, the control of forest pests is primarily a public responsibility. It requires large-scale organization and operation, too big for most forest-land owners to handle individually. The job calls for trained specialists in forest entomology and forest pathology and silviculture. The research needed must be continued over long periods and in many parts of the country—the kind of research that individual forest owners are generally not in a position to conduct. Control operations often must be carried on over wide areas without regard to property lines.

When Congress in 1947 passed the Forest Pest Control Act (61 Stat. 117; U. S. C. 594-1 to 594-5) it recognized the Federal concern and responsibility in the control of forest insects and disease on a Nation-wide basis, and on land in all classes of ownership. The act declared it to be the policy "of the Government of the United States independently and through cooperation with the governments of States, Territories, and possessions, and private timber owners to prevent, retard, control, suppress, or eradicate incipient, potential,

or emergency outbreaks of destructive insects and diseases on or threatening all forest lands irrespective of ownerships." The act paves the way for establishment of more adequate services and facilities for prompt detection and suppression of forest pests.

Department Teamwork

The Bureau of Entomology and Plant Quarantine in the Department of Agriculture provides technical leadership in matters of forest insect control. It advises the Forest Service and other Federal forest-land managing agencies on insect-control problems. The States and private landowners also may obtain technical information and advice from that bureau.

It is the function of BEPQ to detect outbreaks and identify forest insects, determine the extent of infestations and a measure of their economic potential, and, where appropriate, to advise on or direct control activities. The bureau conducts research on forest insects and their habits, and on development of new insecticides and control methods. BEPQ maintains forest insect specialists at several of the Forest Service's regional Forest and Range Experiment Stations, who work on regional pest problems in cooperation with forestry specialists in other fields.

Research on forest tree diseases is conducted by the Division of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering. The division also maintains specialists at most of the Forest and Range Experiment Stations, and provides technical advice and services on tree-disease problems to the Forest Service and other forestry agencies.

Upon being advised by the forest entomologists or pathologists that a forest pest is attaining epidemic proportions on a national forest, and that control operations are biologically feasible, the Forest Service sizes up the values at stake and makes the decision as to whether control expenditures are economically desirable. If control is decided upon and the necessary funds are available, the Forest Service then carries on the control operations, with the entomology or forest pathology specialists acting in a technical advisory capacity. Where extensive State or private holdings are intermingled with national-forest lands, various cooperative arrangements may be made. In the case of the Oregon spruce budworm project, for example, the Federal Government contributes one-fourth, the State three-eighths, and the private landowners the remaining three-eighths of the cost of control operations on private lands.

Control operations wholly on non-Federal lands may be directed by BEPQ, with the States and private owners sharing costs, or the State forestry departments may direct the work under technical guidance of BEPQ. A number of States now have entomologists and forest pathologists attached to their forestry staffs, and several States have laws placing responsibility with the State forestry departments for insect and disease control work on non-Federal lands.

Operations in 1951

During the fiscal year 1951, \$3,729,458 appropriated under the Forest Pest Control Act was expended. Of this amount, \$239,500 was spent for detection and appraisal surveys by the Bureau of Entomology and Plant Quarantine, and \$41,500 was spent by the Bureau of Plant Indus-

try, Soils, and Agricultural Engineering, mainly for work on the oak-wilt disease and on pole blight of western white pine. With the balance, control operations of significant proportions were carried on in 14 States, along with numerous small projects undertaken in various places throughout the country.

The control work handled directly by the Department of Agriculture was done by the Forest Service, primarily on national-forest lands, with BEPQ advice. In some instances the Forest Service also carried on control work on other public lands, as in the Oregon spruce budworm control project, where lands under jurisdiction of the Department of Interior's Bureau of Land Management and the Indian Service were sprayed under direction of the Forest Service in conjunction with the spraying of adjacent national-forest lands.

For the control season ending December 31, 1950, 25 separate pest-control projects were conducted in 45 national forests. A total of 842,319 beetle-infested trees were individually sprayed, and 966,267 acres were broadcast sprayed, mostly by airplane. Among the major projects carried on, in addition to the spruce budworm control project in the Pacific Northwest and the Engelmann spruce beetle project in Colorado, were control operations against pine bark beetle infestations in the California Sierra, in the Kootenai National Forest in Montana, and in the Targhee, Caribou, and Teton National Forests and Grand Teton National Park in Idaho and Wyoming.

White pine blister rust control work was carried on under a separate appropriation on 191,392 acres of national-forest land, 69,490 acres of Indian, National Park, and O & C lands, and 1,128,985 acres of State and private lands during 1950.

An Urgent Need

Most native forest insect and disease pests, and many of the introduced ones, are so well established and so widely distributed that their complete eradication would be practically impossible. Nevertheless, it is possible and feasible to establish a satisfactory degree of control over the more serious pests. It is possible and feasible to eradicate a newly introduced pest that is still confined to a limited area. And it is possible to keep other new pests from entering this country. It is urgent that we apply the necessary measures to keep the losses caused by these pests to the lowest practicable level.

More Research Essential

Basic to an effective pest-control program is knowledge of the pests and how they work. Much valuable research has been done; much more is needed.

Research on forest insects and diseases has been conducted largely by public agencies, most of it by the Department of Agriculture. Some States are conducting research on various pests, through their agricultural experiment stations or forestry schools. Private research efforts in these fields have been chiefly directed toward the development of preservatives and treatments to protect wood in use. Commercial developments in insecticides and herbicides also have been of value in forest control operations.

State and private agencies should continue to do all they can. But it devolves upon the Federal Government to see that the Nation as

a whole has the necessary technical information on which to base control. The Department of Agriculture should continue to work for the effective correlation of Federal, State, and private activities, and to serve as a national clearing house for research findings. It should be enabled to expand its program of basic research on the insects and diseases affecting each important timber type in the United States. More study is needed also on foreign pests. Additional knowledge of dangerous foreign insects and diseases that might get into the United States could help provide practicable means for keeping them out.

Quick Detection and Attack

A well-organized detection system can discover many small outbreaks of forest insects or diseases before they develop into epidemics. Early indications of an incipient epidemic can be recognized by trained technicians. Introduced pests usually develop first in localized areas. Their discovery should not be left to chance, but should be provided for by a permanent, organized detection system. This calls for inspection units of trained forest entomologists and forest pathologists. It calls also for the participation of Federal land-managing agencies, State agencies, and private landowners, with over-all leadership and correlation by the technical bureaus of the Department of Agriculture.

As in forest-fire control, prompt action against forest pests will keep down both the cost of control and the losses. Too often, valuable time has been lost in attacking insect or disease epidemics while organizing for a special project and while waiting for the necessary Federal or State funds to become available.

Obviously, when control of an epidemic is undertaken, it must be carried through to completion. Otherwise the work may be wasted effort. And the control program, to be successful, must be applied over all lands involved. Many pests are common to an entire region, and epidemics often extend across State boundaries, making cooperation between States, and between States and the Federal Government, necessary for efficient control.

The Forest Pest Control Act of 1947 provides the foundation for such a program of detection and control. Fully implemented, it will make possible the prevention of great losses in the forests.

Good Forest Management

In the long run, good forest management, applied Nation-wide, will help greatly in the defense against most insects and diseases. Healthy, vigorous trees in well-managed forests generally are better able to resist attack.

There are exceptions to the rule that young, vigorous trees are more resistant. Blister rust will kill young white pines faster than old ones. Some of the tip moths, sawflies, and twig weevils are most destructive in sapling-size stands. But in general, forestry practices that produce vigorous, fast-growing crops of trees of species well adapted to the site will reduce losses from insects and diseases. And for blister rust and some of the others, special methods of silvicultural management have been devised to aid in their control.

The use of proper forestry methods in harvesting timber from over-mature forests converts these to thrifty, growing forests. The trees

most susceptible to attack by certain bark beetles and by many other insects and diseases are eliminated. Heart-rot fungi generally are most prevalent in old stands, so development of high-grade timber forests on commercial rotations will prevent much of the heavy loss from heart rots.

An adequate system of timber-hauling roads is one of the first essentials to the management of forests for continuous high-grade timber production. Close utilization is impossible without accessibility. A road system adequate for utilization of the timber under sustained-yield management also makes all parts of the forest accessible for fire and pest control. It makes possible special forest-management practices to control species or age classes in the interest of insect or disease protection. It also makes it possible to salvage timber killed or dying as a result of the action of forest pests, before deterioration renders the timber worthless. Progress in solving insect and disease control problems will be greatly facilitated by the extension of permanent access road systems in the national forests and commercial forests in other ownerships.

THE PROGRAM FOR FORESTRY

In the job of building up and maintaining our forests for maximum production and service, protection against fire, insects, and diseases is extremely important. Losses from natural enemies, if not prevented, can nullify much good work in forest management, both on public and private land. Owners of forest land cannot be expected to invest in long-term, timber-growing enterprises if the risks remain too high.

With advancing knowledge and experience, forestry services and the cooperating technical agencies have now developed methods for effective control of forest fires and of some serious forest insects and diseases. It is possible and feasible to apply protection against the natural enemies of the forest to a degree that will reduce losses to a tolerable level. The costs of such protection will not be excessive in comparison with the values at stake.

But protection is not the sole answer to the forest problem. Even if the total annual loss from fire, insects, and disease were entirely eliminated, saw-timber drain would still exceed annual saw-timber growth.

Destructive as the natural enemies of the forests can be, the most destructive force in the forests has been man himself. It was largely man's carelessness, wastefulness, and shortsightedness that reduced the forest-growing stocks over large parts of the country below the level needed to sustain even the present rate of saw-timber cutting.

But man can, by the application of positive forest management, build up growing stocks, make and keep forest lands permanently productive. On nearly one-fourth of the commercial forest lands of this country, mostly on the public forest lands and large industrial holdings, he is applying good management now. On another one-fourth, the forest-management practice can be classed as fair. But more than half of the commercial forest land is still being handled poorly or destructively.

Even though full and effective protection against the natural enemies of the forest were available, there would still remain the big

job of raising the general level of forest management in this country to a point where ample and continuous forest products and benefits can be assured.

Adequate protection is a part of the broad program for American forestry advocated by the Forest Service, aimed at building up and maintaining forest growth to meet our future requirements. The program is based on the belief that forest conservation requires the Federal, State, and local governments, and private owners and agencies to act in effective cooperation. It calls for the expansion and intensification necessary to attain adequate fire protection both on public and private forest lands. It calls also for the strengthening of protection against forest insects and diseases.

The program looks also to further encouragement of good forest management through public aids and services to private owners. Technical assistance to private owners on forest management and marketing problems should be made available on a broader scale, especially to the owners of small forest holdings, relatively few of whom are yet practicing good forestry. Forest planting on private lands should be greatly accelerated through increased cooperative aid. A forest credit system is needed to make long-term loans available on terms and conditions suitable for forestry purposes. And as a basic means of aiding forestry and improving wood utilization, and phases of forest research should be strengthened and expanded.

Another part of the comprehensive program for forestry calls for positive action to stop further forest destruction and deterioration and so help maintain a reasonable growing stock as a basis for future production. The plan advocated is a system of public regulation of cutting and other forest practices, administered by the States. Fourteen States already have laws regulating forest practice in one way or another. To assure a consistent Nation-wide pattern, a Federal law setting up basic standards will be needed.

Along with these measures looking to better forest management on privately owned lands, the development, expansion, and intensified management of national and State forests should be vigorously pushed. The public forests are becoming more and more important in helping to meet the Nation's timber needs. They include watershed lands of vital importance to irrigation agriculture, to the water supplies of hundreds of cities and towns, and to stability of stream flow in major streams. Properly developed, these public forests can contribute increasingly to local and national welfare.

Such a broad national program of forestry will require not only the protection of the forests to prevent the loss of existing values, but positive management to build up and sustain forest productivity. A program along these lines, the Forest Service believes, will assure eventual forest abundance.

FORESTRY AND NATIONAL PROGRAMS

During the past year, increased public attention was directed to forestry in the formulation of national policy. This interest may be attributed to a growing understanding of the multipurpose role of forest resources in the economy of the Nation, as well as to the worldwide shortage and the strategic importance of timber products.

The Forest Service sought to gear its programs and policies for maximum contribution to the objectives of defense production and related civilian preparedness. Working through the recently created National, State, and County Mobilization Committees, the Service coordinates its efforts with those of other agencies of the Department of Agriculture.

Defense Production Activities

The National Production Authority in the Department of Commerce is the principal Government agency to which the forest industry looks for guidance on defense production matters. The services of the Forest Service in the Department of Agriculture were offered for use in an advisory and facilitating capacity on those jobs which its widespread field organization and personnel trained in forestry and forest products were especially equipped to handle. An agreement between the Secretaries of Commerce and Agriculture was worked out along these lines. Under this agreement, the National Production Authority is making extensive use of the Forest Service for special studies and reports needed to administer action programs and overcome difficulties in the forest-products field.

The National Production Authority receives applications for accelerated tax amortization and for Government loans for plant expansions, and makes the final recommendations to the Defense Production Administration, the certifying authority for such tax amortizations or loans. When forest products are involved, however, NPA refers the application to the Forest Service for field investigation and advice as to the adequacy of timber supply in the territory tributary to proposed plant expansions.

In the aggregate, the proposed expansions will represent a potential new drain on the country's timber resources of considerable proportions. The Forest Service ascertains whether the timber supply is adequate for proposed expansions of plant facilities and whether such expansions will cause an excessive concentration of installed wood-using plant capacity in the area. The Forest Service does not wish to be a party to any plant expansion that would disrupt existing industry, or that would jeopardize sound long-term developments by causing over-drain and depletion of the forest resources.

Up to August 21, 1951, nearly 250 applications from forest-products industries had been referred by NPA to the Forest Service for review. Most of the applications were for additional expansions in the pulp and paper industry. Others were for increased production of softwood plywood, rayon textiles, and lumber, and for wood-treating plants.

A large proportion of the applications contemplate plant expansions in the Southern States, although many also have been sent in from the Northeast, the Lake States, and the west coast. In many forest areas the installed plant capacity is already much in excess of the growth rate of local timber; but there are a number of places where expansion of plant capacity is possible and desirable, especially where the expansion is based on increased utilization of hitherto little-used species, or mill or woods waste.

During the year, the Forest Service made a number of special surveys and studies to aid and facilitate the defense program. The

Forest Products Laboratory carried on a number of special defense projects for the military services. The Forest Service's Engineering Division continued services in photogrammetry for the Navy Hydrographic Office.

Interagency Programs

Additional responsibility in forestry leadership was placed in the Forest Service as a result of reorganization within the Department of Agriculture aimed at coordinating all services in the field of agricultural resources conservation under the supervision of an Assistant Secretary designated for this purpose.

Planning for River-Basin Development

Interagency committees have been organized for the Arkansas-White-Red River Basin and the New England-New York region. The committees in each of these regions will make a comprehensive survey of the region's water and land resources, and recommendations for their development, utilization, and conservation. Department of Agriculture field committees were established to participate in the investigation and development of these comprehensive river-basin plans. Through representation on these committees, the Forest Service will help to develop the forestry and related phases of the water and land resources problem and to coordinate and integrate them with other agricultural and nonagricultural programs for the regions.

Progress also was made on programs aimed at comprehensive agricultural plans for the Missouri and Columbia River basins. Through representation on the Department field committees for these areas, the Forest Service aided in the development of these plans, particularly with respect to the protection, utilization, and productivity of the forest and range resources. The Forest Service and the Soil Conservation Service jointly prepared an analytical report on the adequacy of flows in the Missouri River to satisfy the water requirements of the comprehensive over-all basin development plan.

Flood-Control Projects and Surveys

Flood-control survey reports were being prepared by the Forest Service, in cooperation with the Soil Conservation Service, for the watersheds of the Connecticut and Merrimack Rivers in New England, the Upper White River of Missouri and Arkansas, Fountain River in Colorado, Boise River in Idaho, San Gabriel-Santa Ana and Santa Clara-Ventura Rivers in California, and of the streams draining the Wasatch Front in Utah, and San Diego County, Calif.

The Forest Service is participating in flood-control projects authorized by Congress in the watersheds of the Coosa, Little Tallahatchie, Los Angeles, Potomac, Santa Ynez, and Yazoo Rivers. On the Los Angeles and Santa Ynez drainages, burned areas were held to a minimum through intensified protection during the dry period of 1950. In the Little Tallahatchie-Yazoo areas in Mississippi, nearly 7,000 acres were planted to trees. Local interest and participation mounted so rapidly that it was not possible to meet all requests for planting stock. Through cooperative action with the State of Mississippi, rapid progress is being made in extending fire protection to all forest lands in these two watersheds.

Family Farming

A provisional report prepared by the Department of Agriculture in connection with its program for the strengthening of family farming in America included recommendations regarding forest-resource policy. This report brought out that present policies and programs for administering the national forests are well adapted to serve the needs of family farming. Because of the multi-resource contributions of the national forests to the national economy and welfare, all farmers share indirectly in the benefits. Many farmers also benefit directly from employment and business opportunities afforded by use of the national-forest resources. National-forest timber is available to them for home or commercial use; forage on national-forest ranges is available to thousands of family farms. Especially important in irrigated areas, the protection and management of national-forest watersheds benefit intermingled, adjacent, and downstream farms. Among numerous other benefits, national-forest recreation and wildlife contribute to the amenities of family farm living.

Established programs of cooperative fire protection, aid in woodland management, and other services to private forest-land owners are particularly helpful to farmers and other small owners. Family farms also benefit from the Forest Service research programs, all of which are aimed partly at stabilization of the economy of rural communities.

THE NATIONAL FORESTS

Cash receipts from national-forest operations during the fiscal year 1951 reached an all-time high of \$56,147,342. The returns to the United States Treasury exceeded the expenditures for protection and management of the national forests by more than \$17,000,000. Receipts even exceeded the total of all appropriations for the national forests, including appropriations for capital expenditures such as purchase of land, road and trail construction, and permanent improvements.

Many individual national forests have been yielding receipts in excess of operating costs for years. Last year was the first year, however, that cash income exceeded all costs for the national-forest system as a whole. Most of the receipts were from the sale of timber. The bulk of the revenue came from less than half of the area. Large portions of the national forests are noncommercial forest lands that produce very little cash revenue, although many of these lands have very high watershed, recreation, and other values. The national-forest system also includes large areas of recently acquired cut-over and burned-over forest land which now brings in little cash income, but which may be expected to bring in more as new timber growth is built up.

The purpose of the national forests, however, is public service, not cash profit. Undoubtedly the greatest returns to the public are not monetary—such things as safeguarding the water supplies of hundreds of cities and towns and farm irrigation systems, reduction of flood danger, community stability and employment resulting from national-forest resource management; the health-giving enjoyment experienced by millions of recreationists; the forests' scenic and inspirational values. The money value of national-forest water sup-

plies for irrigation and domestic use alone has been estimated at \$300,000,000 a year. But it would be impossible and unwise to try to place a dollar-and-cents value on many of these nonmonetary returns to the public.

An amount equal to 25 percent of the gross receipts of the national forests each year goes to the States for distribution to the counties containing national-forest lands. The counties' share of national-forest receipts is used for local schools and roads. An additional 10 percent of receipts is allotted for expenditures on national-forest roads in the States of origin.

Timber Management

The volume of timber cut from the national forests in fiscal year 1951 totaled 4,688,000,000 board feet, the highest for any year since the national forests were established. This was an increase of more than 1 billion board feet over the volume cut in the preceding year. The annual cut has practically doubled since 1943.

A total of 25,451 timber sales was made during the year. Of these, 20,683 were small sales (less than \$1,000) ; 811 were between \$1,000 and \$5,000; and 905 were over \$5,000. There were 3,052 sales of miscellaneous forest products.

Management of timber for continuous production of usable crops is not possible without markets. The better the markets, the more intensive management may be. Today's management of national-forest timber resources includes practices now considered routine that were mere silvicultural dreams a few years ago.

Lodgepole pine in eastern Oregon was once considered of such little commercial value that it was not included in timber inventories. These tallied only the intermingled ponderosa pine. This same lodgepole pine is now in demand for saw timber at stumpage prices exceeding those obtained for the best ponderosa pine 15 years ago.

In September 1950 there was spirited bidding on an offering of 168 million board feet of medium-quality ponderosa pine in the northern portion of Kaibab National Forest, Ariz., more than 150 miles from the nearest railroad. Kaibab National Forest was created nearly 60 years ago, but until very recently there has been no demand for the timber in this outlying part of the forest, since ample supplies were available in more accessible areas.

For the right to cut 171,000 cords of jack pine, spruce, and balsam fir from the Superior National Forest in northern Minnesota, two pulp companies bid against each other for 6 hours at an auction sale conducted by the Forest Service in Milwaukee in November 1950. Twenty years ago foresters deplored the fact that the timber in this remote area was deteriorating because there was no demand for it.

In May 1951 in the Nantahala National Forest, N. C., 27½ million feet of old-growth Appalachian hardwoods and softwoods sold for almost a million dollars. In a region where lumbering has been extensive, this was a stand of timber that had been left uncut because of difficult operating conditions in the mountains.

These examples show the effects of improved markets on the expansion of management to remote areas of the national forests and to hitherto unused species. Silvicultural practices also are being intensified in many national forests. Demand for pulpwood makes pos-

sible thinnings in crowded young stands of southern pine, for example, and release cuttings in the Lake States to remove an overstory of aspen and enable young softwoods to develop more rapidly. Light, frequent cuts such as these mean reduced mortality and greater yields per acre.

Even without further development of markets the yearly cut of national-forest timber can be increased some 50 percent through the construction of about 4,000 miles of main-line timber access roads during the next few years. Inaccessibility is the principal bottleneck in obtaining timber supplies.

Inventories of timber resources and the preparation of timber-management plans were continued during the year to the extent that it was practicable to finance this work. During the year 18 timber-management plans were approved covering 1,821,000 acres of commercial forest land within the national forests, with a potential sustained-yield annual cut of 290,300,000 board feet. Inventory and management-plan work is a necessary preliminary to timber sales. This work, however, is not up to schedule, and only the most urgent jobs can be undertaken when there is such great pressure for the use of available manpower and funds in preparation and administration of current timber sales.

Ceiling Prices

After the General Ceiling Price Regulation was issued by the Office of Price Stabilization on January 26, 1951, sales of national-forest timber were suspended until appropriate ceiling prices for national-forest stumpage could be determined. Ceiling prices were announced and sale activity was resumed in early February. However, an amendment to the General Ceiling Price Regulation issued in late February forced the Forest Service again to suspend sales activity because of the impracticability of applying the provisions of this amendment to national-forest timber, which by law must be advertised for sale to the highest bidder.

The Office of Price Stabilization came to the conclusion that ceiling prices on stumpage were inadvisable and in April issued Supplementary Regulation 17 which authorized sales without ceiling restrictions. National-forest timber sales were promptly resumed.

National-forest timber is offered for sale at prices which are calculated to allow the purchaser a fair margin of profit and risk. The effects of ceiling prices on lumber and other forest products under the General Ceiling Price Regulation are being taken into account in the stumpage appraisals.

Alaska Pulp-Timber Sale

The Forest Service in July 1951 made final award to the Ketchikan Pulp & Paper Co. on its bid to purchase 1½ billion cubic feet of timber in the Ketchikan pulp-timber unit of the Tongass National Forest in Alaska. Preliminary award was granted to the company in 1948 following advertisement and receipt of bid for the proposed sale. The company in 1951 completed requirements for qualification for final award and made a satisfactory showing of its ability to meet contract terms.

Terms of the sale contract require construction of a pulp mill of at least 300 tons daily capacity. It is estimated that the plant will

employ 800 persons when installations are completed. The proposed mill will be located at Ward Cove near Ketchikan.

The sale was made on the basis of a 50-year cutting contract, with prices to be reappraised in 1964 and at 5-year intervals thereafter. The bulk of the timber covered in the sale is on the northerly portion of Prince of Wales Island. It is 75 percent hemlock, with the balance mainly Sitka spruce and small amounts of Alaska and western cedar.

Provision for conservation of the natural resources of the area was one of the major features of the timber sale agreement. This includes handling of the timber on a sustained-yield cutting plan, safeguarding of salmon spawning streams so important to the huge fishing industry of Alaska, prevention of pollution, and preservation of the significant scenic values.

Sustained Yield Units

The Lakeview (Oregon) Federal Sustained Yield Unit was established October 10, 1950, following a public hearing and lengthy consideration. This action was appealed by the Willow Ranch Co. which operated a sawmill in California, 22 miles from Lakeview. After further study and hearings, the Secretary of Agriculture, on February 19, 1951, upheld the decision of the Chief of the Forest Service approving establishment of the unit.

The Lakeview unit was established under authority of the act of March 29, 1944 (58 Stat. 132; 16 U. S. C. 583-583i). It is designed to aid the stabilization of the local economy by requiring primary processing of national-forest timber from the unit to be done in the communities of Lakeview and Paisley. The several sawmills in these communities have a total installed capacity of some 65 million board feet, but private timber tributary to these mills is practically exhausted. The allowable annual cut from the Federal unit, 50 million board feet, will be sold competitively, subject to the requirement for primary manufacture in the designated communities. Local re-manufacture also will be encouraged, to further community stabilization.

A few proposals for additional sustained-yield units are under consideration. Each proposal is subjected to searching study. Many have been rejected. Six units have been established. The first, the Shelton unit, is a cooperative sustained-yield unit involving both national-forest and private lands. The others are Federal units involving only national-forest lands. The units established to date are:

<i>Name</i>	<i>State</i>	<i>Date established</i>	<i>Allowable annual cut (million board feet)</i>
Shelton-----	Washington-----	Dec. 12, 1946-----	100. 0
Vallecitos-----	New Mexico-----	Jan. 21, 1948-----	1. 5
Flagstaff-----	Arizona-----	May 6, 1949-----	61. 0
Gray's Harbor-----	Washington-----	Nov. 2, 1949-----	60. 0
Big Valley-----	California-----	Jan. 27, 1950-----	8. 0
Lakeview-----	Oregon-----	Oct. 10, 1950-----	50. 0
Total-----			280. 5

Reforestation

The Anderson-Mansfield Act of October 11, 1949 (63 Stat. 762), provides authorization for the appropriation of funds to reforest more

than 4 million acres in the national forests during a 15-year period. The authorization for fiscal year 1951 was \$3,000,000. The appropriation actually available was \$1,094,000. Twelve active nurseries produced 32,637,000 trees for national-forest planting during the year. Total area planted and seeded was 46,121 acres.

The act provides increased annual authorizations up to \$10,000,000 for fiscal year 1955 and thereafter. The Forest Service is prepared to carry on this important job when and as the authorized appropriations become available. Five additional Forest Service nurseries are now being used by others. These are the Licking Nursery in Missouri, the Knife River Nursery in Minnesota, the Stuart Nursery in Louisiana, the Hayward Nursery in Wisconsin, and the Wyman Nursery in Michigan. Their combined annual capacity is 59½ million trees. The Knife River Nursery has been leased to a lumber company; the others to State forestry departments. Leases are being negotiated with State agencies for three other nurseries—the Towner in North Dakota, Hugo Sauer in Wisconsin, and the Parsons in West Virginia with a total capacity of 16½ million trees. Arrangements can be made to obtain part or all of the production of these nurseries for national-forest planting whenever the planting program can be stepped up to the rate contemplated in the Anderson-Mansfield Act.

Three years ago, the Ashe Nursery in Mississippi was closed down because of a disease problem which had made the nursery unproductive. Studies by pathologists, soil scientists, and silviculturists resulted in prescription of satisfactory control measures; during the past year, therefore, the Ashe Nursery was returned to production.

Range Management

During 1950 the Forest Service issued 19,900 pay permits to livestockmen authorizing them to graze 1,091,680 cattle, 3,006,185 sheep, and 92 swine on national-forest ranges. In addition, 34,329 cattle, 6,457 sheep, and 1,859 swine kept for domestic purposes by 3,645 owners (exclusive of those who also held pay permits) were permitted to graze under the regulation allowing free permits to local settlers.

Forty-five million acres of range within the national forests is used by cattle and 18 million by sheep. Almost 5 million acres in addition is used in common by sheep and cattle. Six million acres of range is not used by domestic livestock on account of the greater need for its use for timber production, recreation, game animals, watershed, or other purposes.

The great majority of national-forest grazing permittees are small operators. Latest records show that only 7 percent of the cattle permittees graze more than 200 head; only 4 percent of the sheep permits are for more than 4,000 head. The average cattle permit is for 67 head; the average sheep permit for 1,178 head.

Grazing fees on the national forests are adjusted each year in accordance with the market prices of livestock for the preceding year. Because of the high market prices received by producers in 1950 for beef cattle and lambs, the grazing fees reached an all-time high in 1951, averaging 51 cents for cattle and 12¼ cents for sheep per head per month. Total grazing receipts for the fiscal year 1951 amounted to \$4,165,574.

Problem Areas

Among the national-forest lands devoted to grazing use there are several especially acute problem areas, notably in South Dakota, Colorado, Wyoming, New Mexico, and California. Controversies between local stockmen permittees and forest officers have arisen over some of these areas. The Forest Service and the Secretary of Agriculture are giving special attention to the problems involved. During the past year, technicians and administrators not immediately connected with the controversial areas or issues were asked to examine some of the areas and check on the decisions and methods employed by local forest officers in making adjustments in numbers of animals allowed to graze or in the season of use.

Among the problem areas where outside experts reviewed range problems and inspected range conditions and vegetative readiness was the North Warner Mountains Division of the Modoc National Forest in California. The grazing problem here is one of long standing. This is one of a number of areas where the capacity of neighboring ranches for wintering cattle exceeds that of the national forest for summering them. The heavy demand for summer grazing has subjected the range to long-continued overgrazing. Because of determined opposition by a few individual permittees to adjustments in grazing use, it was felt advisable to have the judgment of the local and regional forest officers cross-checked by two Forest Service technicians not directly connected with the local administration. The investigators found unquestionable evidence of the need for easing grazing pressure in the North Warner Mountains, and worked with local people on the program to correct the situation.

A special 1-year study by the Division of Range Research of two range units on the Roosevelt National Forest in Colorado was completed during the past year in line with suggestions contained in a report of the National Forest Advisory Council made in 1949. The major objectives were to determine in an area that has become controversial just how effective adjustments in livestock use had been and whether or not additional adjustments or other measures might be needed to obtain desirable range management and promote satisfactory watershed conditions. Although 96 percent of the usable range area is not producing forage to the full extent of its capability, past reductions in grazing, especially those made in the last 5 to 10 years, have had a beneficial effect on the range. It is believed that the present rate of stocking can be continued for the time being. Watershed conditions, once considered critical in the area, have improved, and a slow recovery of the better forage species is evident. Improved range management and better distribution of livestock should hasten recovery. Several new guides for use in judging the condition and trend of range-watersheds were developed which will be generally helpful to range administrators and stockmen alike in securing a better understanding of grazing management of watershed areas.

The Forest Service is fully aware that reductions in grazing use sometimes have an adverse economic effect upon the operations of grazing permittees. Nevertheless, it has the responsibility of so regulating grazing use as to safeguard both range and watershed values. Maintenance of range productivity is essential to the long-term welfare of the western livestock industry, and most national-forest range

lands are watersheds of vital importance to the Nation's water resources. It was because the Forest Service, in trying to avoid too sudden or too serious effects on the permittees' operations, sometimes moved too slowly in making needed reductions in years past, that there has been continued deterioration of range conditions in some of the problem areas. In making necessary range adjustments, however, the Forest Service will continue to take into account not only the preservation of range and watershed values but the impact on the economic welfare of individual permittees.

Range Improvements

For fiscal year 1951, Congress appropriated \$700,000 for range improvements and approximately \$715,000 for range revegetation on the national forests. The total investment in range improvements, exclusive of range reseeding, up to June 30, 1950, amounted to approximately \$16,560,000. Improvement work accomplished included construction of 27,000 miles of range fence and corrals, 3,500 miles of livestock driveways, 16,000 water developments, control of poisonous plants on 33,000 acres, and control of rodents on 6,255,000 acres. A total of 400,000 acres has been reseeded to palatable forage species.

At the present annual rate of appropriation it will take 65 years to complete the range-revegetation program for the national forests and 30 to 40 years to complete the range-improvement program. Over 50 percent of the funds currently available for range improvements is required for maintaining existing improvements, leaving very little for construction of new improvements.

Advisory Boards

Section 18 of the Granger-Thye Act of April 24, 1950, provides for the establishment of forest advisory boards whenever a majority of the grazing permittees on a national forest or a subdivision thereof petitions the Secretary of Agriculture to form such a board. A tentative regulation was prepared to carry out the provisions of section 18, and after ample opportunity had been given to the more than 800 existing livestockmen's advisory boards, to individual permittees through their associations, and to other interested representatives of the livestock industry to study and advise on this, a new national-forest regulation, G-10, was approved on April 14, 1951.

It will be the policy of the Forest Service to make the fullest possible use of advisory boards constituted and elected or recognized under the Granger-Thye Act. Working through these boards, forest officers will make every effort to give grazing permittees a clear understanding of policies and procedures and to obtain the benefit of their advice in the formulation and application of national-forest grazing policies and programs. Section 18 of the act requires that each advisory board be advised in writing of the reasons for overruling or modifying any of its recommendations, and this requirement is included in the instructions under regulation G-10.

It will be necessary to amend the earlier regulation G-7, which covers "Cooperation With Stockmen," in order to avoid conflicts with the new regulation G-10 and to provide for participation by permittee livestock associations and advisory boards not covered by regulation G-10. A preliminary draft for revision of regulation G-7 and the

attendant instructions has been sent to Forest Service field officers and to representatives of the livestock industry for review and comment.

National Forest Advisory Council

The National Forest Advisory Council is composed of three consultants designated by the Secretary of Agriculture to advise him on policy questions in connection with administration of the national forests. Last year, the Advisory Council, at the request of a joint committee of the American National Livestock Association and the National Wool Growers Association, reviewed certain features of national-forest range management policy. The council conducted a hearing in Denver, attended by representatives of the livestockmen's associations and others.

When reduction in permitted number of livestock on a grazing allotment is necessary, the Forest Service has made it a practice, whenever possible, to make the needed adjustments at a time when a grazing permit is transferred from one party to another. It was believed that reductions at the time of transfer would generally cause less hardship to permittees than at other times. The Advisory Council recommended retention of this policy covering transfer adjustments, but suggested certain measures for clarification of procedure.

The council recommended that the procedures for dealing with grazing trespass cases be incorporated in the National Forest Grazing Manual, so that livestockmen and others could more easily be fully informed of the trespass provisions. The Forest Service has already taken steps to put many of the council's recommendations regarding trespass procedure into effect.

In the public interest as well as in the interest of national forest users, the council recommended that the Forest Service and other Department of Agriculture agencies make every effort to help grazing permittees improve the productiveness of their own lands in order to lessen their dependence on Federal lands.

While numerous magazine and newspaper articles have helped to keep the interested public informed on national-forest grazing matters, the council found that some articles have had adverse effects in leading many stockmen mistakenly to believe that the Forest Service's range-conservation measures are a step toward total elimination of grazing from the national forests. Repeatedly the Forest Service has stated that, on the contrary, its program looks to building up and maintaining the national-forest ranges so that, consistent with the protection of watershed and other values and uses of the range, they can make their maximum contribution to a permanent and stable livestock industry. The council recommended intensified educational and informational effort designed to promote a better public understanding of national-forest objectives.

Watershed Management and Flood Control

Accomplishments in watershed-improvement work, although not always apparent in day-to-day observations, are often significant when viewed over a decade or more. On the Pike and San Isabel National Forests in Colorado, for example, watershed areas where depletion was critical are now beginning to show noticeable recovery

trends as a result of corrective steps begun during the Civilian Conservation Corps period.

A number of special watershed-improvement projects were under way during the past year. In California, the Forest Service was cooperating with the Bureau of Reclamation in rehabilitating lands adjacent to the Shasta and Keswick Reservoirs. These lands were denuded by smelter fumes during early-day mining operations. A combined job of tree planting by the Forest Service and the installation of some 13,000 small check dams for erosion control by the Bureau of Reclamation was in progress.

Several projects in Utah are showing excellent progress. The Tropic project on the Dixie National Forest is an outstanding job in which local water users, stockmen, and the Forest Service are cooperating to control soil and channel erosion and check reservoir sedimentation. Sediment in upstream channels is being controlled by small rock and earthen dams. The work is financed by funds raised by the water users and stockmen through annual assessments against shares of water and numbers of cows grazed. The Forest Service is contributing to the land-management aspects of the project with a range reseeding program that is reducing grazing pressure on the depleted watershed lands. The project appears to be rapidly reducing the sedimentation rate in Tropic Reservoir.

The Weber County Watershed Protective Corporation, a group of civic-minded citizens, is aiding in the purchase of flood and sediment-producing watershed lands above the Pine View Reservoir near Ogden, Utah. The program was started after a heavy flood in 1946. Since then the citizens' group has arranged for the purchase of 6,500 acres of depleted watershed land to be included in the Cache National Forest. The group has raised half of the \$28,000 purchase price through public and private subscriptions; the balance will be met by Federal funds.

Land-restoration measures were started last year on the Mount Pleasant watershed, comprising nearly 12,000 acres of public and private land in and near the Manti-LaSal National Forest, Utah. Largely as a result of overgrazing, this watershed has produced damaging floods 12 times since 1885, the last time in 1946 with damage of more than \$100,000 to the Mount Pleasant community. An active citizens' committee is cooperating with the Forest Service in a program which includes extension of the national forest to include all of the watershed, contour trenching, and reseeding of gullied and denuded slopes.

Emergency Treatments

Two burned areas were given emergency treatment under section 216 of the 1950 Flood Control Act. In Arizona, emergency treatment of the Pinal Creek burned area on the watershed above Globe and Miami, within the Crook National Forest, included airplane seeding of mixed grasses in the ashes on 3,000 acres, supplemented with hand sowing where necessary. In addition, burned pole-size trees on some 300 acres of steep slopes were felled and laid on the contour to control erosion. In New Mexico, some 8,500 acres of Federal, State, and private lands within the Penasco River burn in the Lincoln National Forest were reseeded, largely by aircraft. Trees are to be planted on nearly 400 acres. On some of the critical steep slopes,

burned small trees were felled and other measures taken to help prevent runoff and reduce erosion. The State of New Mexico, private landowners, the United States Army, the Soil Conservation Service, the Production and Marketing Administration, and the Forest Service cooperated in this emergency treatment of the damaged watershed.

Water Developments

Large, multiple-purpose dam projects, such as the Hungry Horse project on the Flathead River in Montana and the Detroit Dam on the North Santiam River in Oregon, will create great reservoirs which will be filled in large part by the runoff from national-forest lands. The reservoirs thus will make it possible for greater benefits to be derived from the water resources of the national forests.

Large reservoir projects also dependent upon and valuable for utilizing national-forest water are being constructed by the Bureau of Reclamation and the Army Engineers in and adjacent to national forests in California. Local communities are reaching into the national forests in this and other States for additional water supplies. Several large reservoirs and generating plants are being constructed by private power companies. Farmers and ranchers continue to build numerous small storage reservoirs in the national forests for irrigation and stock watering. In Alaska, the more accessible of the 200 available power sites are under investigation as potential sources of water and power for the manufacture of pulp from national-forest timber.

The value of the water resources of the national forests thus becomes more apparent each year. Although all this construction for water development is being done by other agencies, the Forest Service is faced with a growing problem of keeping up its transportation system, administrative work centers and improvements, recreation, fire-control, and other facilities that are impaired by the new water developments. Some of the new large reservoirs in the national forests are submerging thousands of acres of what were formerly timber-producing lands. Submergence of roads is complicating the fire protection and timber harvesting on other thousands of acres. Provision is needed for effective restoration of national-forest services so impaired.

Recreation

The public in increasing numbers continues to seek outdoor recreation in the national forests. In 1950 there were over 27,000,000 visits to national forest areas, an increase of 5 percent over 1949. Thirteen million visits were made to public camp grounds, picnic areas, and winter sports areas. The remaining 14,000,000 visits were to organization camps, resorts, summer homes, wilderness areas, hunting country, and fishing lakes and streams. The 27,000,000 visits represented 39,000,000 man-days of recreational use of the national forests.

Moderate charges for camping, picnicking, and swimming at certain of the large, suitably developed recreation areas was continued during 1951. Charges were made at 33 areas, the usual charge being 50 cents per night per party of 6 for camping, and 25 cents to 50 cents per party of 6 for picnicking. Higher charges, up to 25 cents per person per day, were made at four especially well-improved areas in the East:

Sherando Lake in the George Washington National Forest, Va.; Cave Mountain and High Knob in Monongahela National Forest, W. Va.; and Twin Lakes in the Allegheny National Forest, Pa. The Forest Service made special efforts to get responsible concessioners to operate the charge areas, and almost all were operated by concessioners in 1951. Thus the Forest Service was relieved of maintenance and operational costs on these areas. Public reaction to charging continues favorable if the areas are kept clean and properly maintained.

More than 4,000 camping and picnic areas in the national forests remain free to the public. With the limited funds and manpower available for maintenance, however, the operation and upkeep of the free recreation areas by the Forest Service is becoming increasingly difficult as the facilities and improvements become older and as recreation use continues to increase. At many areas sanitary facilities and water systems are no longer satisfactory and do not meet the minimum standards of the United States Public Health Service or the States. Public health and safety are being endangered. Better sanitary control is a "must" if public use of these camp and picnic areas is to continue.

Many recreation areas near population centers are frequently used far in excess of their capacity. Such overcrowding increases the rate of deterioration of the areas and overtaxes the already inadequate sanitary facilities. To relieve current overcrowding, the present total capacity of recreation areas—40,000 family-sized units—will have to be enlarged by at least 10,000 units.

Because of inadequate facilities, many people camp and picnic on unimproved areas where there is danger of polluting water used for domestic purposes. The risks of costly fires are increased when the camper builds his fire in locations which have not been provided with fireplaces.

Winter Sports

A major portion of the suitable skiing terrain in the United States is located in the national forests, and the national-forest winter sports areas are heavily used.

The Forest Service held a training school in the Pacific Northwest region to better equip forest officers in the administration of ski areas, including protection of the public from the avalanche hazard. Considerable progress has been made in developing techniques to accurately forecast avalanche hazard. Observation stations, to observe and record climatic factors influencing the occurrence of avalanches, were established at Heather Meadows on the Mount Baker National Forest in Washington and at Berthoud Pass on the Arapaho National Forest in Colorado. These, with the Alta Station in Utah, will afford observations and studies within each of the three major "climatic snow zones" of the West.

Artificially releasing snowslides with explosives, including artillery shells, is proving a successful means of making dangerous slopes safe for the skier. The Utah National Guard has been of great assistance by making a 75-mm. cannon and crew available on short notice for this purpose at Alta.

The Forest Service has received numerous requests from private, State, and other Federal agencies for assistance in combating the

avalanche threat. Two persons were victims of a fast-moving snow-slide in Colorado last winter, and there were several "near misses" throughout the Rockies. Colorado and several other States are evidencing an interest in the application of techniques developed by the Forest Service to make highway travel safer from the avalanche hazard.

Mining and Special Land Uses

In 1951 some 50,600 special-use permits involving 3,870,415 acres of national-forest land were in force. These permits authorize the use of national-forest land for a variety of purposes, including summer homes, resorts, ski lifts, range fences and water developments, telephone lines, railroads, pastures, etc. Some 21,500 permits for uses which serve public purposes and are of a noncommercial nature were issued free. Charge permits yielded \$656,186 for fiscal year 1951.

Interest in summer-home permits continues to exceed the ability of forest officers to plan and survey tracts for this purpose in most national forests. There were 16,550 summer-home permits in force as of June 30, 1951.

In addition to the special-use permits issued by the Forest Service, 466 Federal Power Commission permits and licenses have been issued for dams, power plants, and transmission lines involving national-forest land. Rights-of-way easements and other permits on national-forest land granted by the Department of the Interior number 794 and cover 124,134 acres.

The Secretary of Agriculture and the Secretaries of the Army, Navy, and Air Force have agreed upon a joint policy to govern use of national-forest land for defense purposes. Under the policy, the Department of Agriculture agrees to make national-forest lands available with a minimum of delay when it is necessary for defense needs. The defense agencies agree to request national-forest land only when other less intensively managed lands are not available or suitable. The defense agencies also agree to keep damage to a minimum and to budget for restoration funds.

Gas and Oil Leases

There has been much interest in gas and oil leases on national-forest lands, especially in western and southern national forests. The Forest Service made 163 reports on applications for acquired land leases under the act of August 7, 1947. In addition, recommendations were made on 1,500 applications for oil and gas leases under the Mineral Leasing Act of February 25, 1920. All together, 3,890 leases are in effect on the national forests, covering 3,445,643 acres. All leases are issued by the Bureau of Land Management, but the Forest Service is responsible for certain land-protection stipulations. Receipts from oil and gas leases on national-forest land withdrawn from the public domain are not credited as national-forest receipts, but are deposited and distributed as other receipts from leases issued under the Mineral Leasing Act. Receipts from oil and gas leases on acquired national-forest lands are credited to the Forest Reserve fund and amounted to \$142,846 in fiscal year 1951.

A set of special stipulations were agreed upon for all oil and gas leases in the Condor Sanctuary, in Los Padres National Forest, Calif. The Department of Agriculture, Department of the Interior, Izaak

Walton League, Audubon Society, and the oil industry cooperated in working out special stipulations under which oil and gas lessees could operate without detriment to the rare California condor which nests in the area.

Mining Claims

There has been considerable discussion of the United States mining laws, and the need for revision of those laws, in newspapers and periodicals and at meetings of conservation organizations. The Izaak Walton League, Society of American Foresters, and National Parks Association have passed resolutions favoring a change in the mining laws, to provide for leasing of minerals or for a separation of the surface and mineral rights in connection with mining claims filed on Federal lands.

Hundreds of new mining claims have been filed on national-forest lands during the past year. Many of these claims include valuable stands of timber. Timber values of \$25,000 per 20-acre claim are not uncommon in the big-timber country of Oregon, Washington, and California. Others claims are located so as to control access to large bodies of merchantable timber owned by the United States. In the opinion of the Forest Service, many of these claims have been located for other purposes than mining.

Every year adds new evidence that the mining laws must be revised if the Forest Service is to manage the national forests in accordance with the best principles of land management. The preemptory right to take and use or abuse public land in a mining claim which the mining law grants makes effective land management impossible in many areas.

Minerals are a resource of national-forest land. They should be developed and exploited for the benefit of our national welfare, but there must be reasonable control on damage to other resources.

Separation of surface and mineral rights is one solution to the problem. It is a solution which would not jeopardize the interests of the legitimate miner, but it would prevent the abuse of the mining laws and interference with the management of the national forests.

Leasing for all minerals, as lands for exploitation of oil and gas and certain other minerals are now leased, rather than outright patenting of land for exploitation of the minerals, would be another satisfactory solution which would not impair the rights of the legitimate miner.

Wildlife

Close cooperative relations in wildlife management are maintained between the Forest Service and the State game and fish departments, and one of the primary aims of the Forest Service is to strengthen these relations and make them more productive. Although cooperation is concerned with many matters, it centers around the States' responsibility in providing and enforcing the laws and regulations which govern the protection and utilization of wildlife on the national forests, and the responsibility of the Forest Service to maintain environmental conditions suitable for wildlife on these Federal lands.

Cooperation in nearly all States is facilitated by special agreements. In some States a broad cooperative agreement outlines responsibilities of the Forest Service and the State. In others specific cooperative

agreements provide for very intensive management of specified national-forest areas and the sharing of special hunting and fishing fees which are collected by the State. Agreements in this latter category are in effect in the States of Arizona, Florida, Georgia, Alabama, Tennessee, North Carolina, and Virginia.

Legislation recently passed in West Virginia will strengthen and expand cooperative wildlife management in the national forests of that State. The legislation provides for the collection by the State of a special fee of \$1 for hunting and \$1 for fishing on national-forest lands. A similar method has worked exceptionally well in Virginia for a number of years. The funds collected by the States are used in the national forests for intensive and cooperatively executed wildlife habitat and management programs.

Habitat Improvement

In the Allegheny National Forest in Pennsylvania a special habitat-improvement program finished its second successful year under a cooperative agreement. Here special emphasis was placed on the creation and development of openings for wildlife in dense forest areas. Although primarily for small game, such as rabbits and grouse, these openings and their food plantings were of considerable benefit to the Allegheny National Forest deer herd.

Habitat improvement received emphasis elsewhere in Forest Service-State cooperative management programs. In Arizona, water developments are helping to improve habitat for game. Quail range was improved and extended in the Tonto National Forest by the installation of special watering devices. In the Kaibab National Forest deer and turkeys benefited from new water developments.

In Idaho, a cooperative program to improve browse forage for big game was undertaken. The program included extensive plantings of bitterbrush, a highly palatable deer food, on the Boise National Forest. In the Clearwater National Forest special studies were made on techniques of stimulating low-level sprout growth in browse stands that had grown beyond the reach of deer and elk. In Michigan cooperative habitat management included provision for maintaining a special habitat for sharptail grouse on 24,000 acres of national-forest land. Some special food plantings were also being made in the national forests in the Lake States.

Cooperative programs concerned with big-game management included many studies of forage utilizations, sex and age ratio studies, and joint meetings of State, Forest Service, and other agencies for the purpose of recommending regulations for hunting seasons, bag limits, and special hunt procedures. Among the States which had outstanding examples of cooperative hunt-management planning on a State-wide scale were Utah and Colorado. In these States the planning also involved other interested Government agencies and special-interest groups such as sportsmen and livestock operators. In the far West, the Forest Service and the States of California and Oregon are jointly continuing a sound operating deer-management program in the Modoc and Fremont National Forests.

Many Hunters and Fishermen

The popularity of the hunting and fishing in the national forests is well indicated by the large numbers of hunters and fishermen who

visit the forests each year. The estimate of their numbers for fiscal year 1950 was 1,350,000 big-game hunters, 608,000 small-game hunters, and 3,160,000 fishermen. No estimate was made of the amount of small game and fish taken, but the estimated harvest of big game was 356,000 animals. Among the many species taken were deer, elk, bear, mountain goats, Bighorn sheep, antelope, and moose. The take of deer, estimated at 304,000 head, far exceeded that of all other species.

Improvements and Facilities

Roads and Trails

A total of \$13,648,000 was made available by congressional appropriations during fiscal year 1951 for maintenance and construction of national-forest roads and trails. This total included \$10,348,000 in the regular annual appropriation, and an additional \$3,300,000 in the Third Supplemental Appropriation made in the late spring of 1951. There remained an unappropriated balance of \$13,112,000 of forest-development road funds authorized by the Federal Aid Highway Act of 1950.

Of the \$3,300,000 supplemental appropriation, \$2,500,000 was made available for the construction of timber-access roads, and \$800,000 for the replacement of bridges and restoration of roads and trails damaged by severe storms in California during the autumn of 1950.

In addition to appropriations made available under the Federal Aid Highway Act, \$3,360,039 of 10-percent funds (representing 10 percent of national-forest receipts authorized for expenditure on forest roads) became available in March 1951. These funds were scheduled chiefly for replacement of unsafe bridges and for reconstruction, resurfacing, or construction of roads used for hauling timber.

The national forests are still woefully deficient in suitable road mileage needed for maximum utilization and proper management of the timber. Construction of approximately 4,000 miles of main timber-haul road mileage would make accessible enough timber to increase the sustained annual cut to a total of some 6 billion board feet each year. An extended road system would also permit the salvaging of large amounts of insect-, disease-, and fire-killed timber and wind-thrown timber which is now being lost because of inadequate transportation facilities.

In some national forests, especially in the Western States, operators logging on public land are equipped and financed to build part of the needed timber-access roads. The Forest Service requires the purchasers or loggers of national-forest timber to build most lateral or side roads for timber hauling and all logging spurs. However, regardless of whether timber road construction is financed initially by the Government or by the logger, the Government stands the cost in the end. Appraised stumpage prices must necessarily be lower where the road building is done by the purchaser of Government timber. Government-built roads, on the other hand, greatly enhance the value of Government-owned stumpage. Since accessibility helps to make Government timber available to many purchasers who would be unable to finance large-scale advance road construction, the Government-built roads afford more flexibility in planning sales, more competition in bidding, and greater opportunities for the small logger.

Transportation System

The existing national-forest transportation system consists of 22,664 miles of forest highways, 111,256 miles of forest-development roads, 129,210 miles of trails, and 112 landing fields. States and counties maintain the forest highways as a rule, and in addition maintain partially or wholly about 10,000 miles of forest-development roads. Loggers and others who use national-forest roads maintain 3,000 miles of forest-development roads.

Of the existing transportation system, 10,296 miles of the forest highways and 57,683 miles of roads are unsatisfactory for present-day traffic, while 35,000 miles of national-forest trails are inadequate for forest-fire control and unsuitable for public use. These unsatisfactory conditions are being corrected as funds become available, but at far too slow a pace to keep abreast of modern traffic requirements. Priority has been given in recent years to the improvement of those highways and development roads that make national-forest timber accessible.

A substantial part of the road funds annually available to the Forest Service is now being spent for the replacement of deteriorated and unsafe bridges with permanent-type structures, culverts, or fords. A great many of the older bridges and temporary-type bridges built by the CCC and during World War II are wholly inadequate for the heavy loads now using the roads. Since the replacement program was started following World War II, 2,354 old or temporary-type bridges have been replaced with 757 permanent-type bridges and 1,597 culverts, at a cost of \$7,682,400. An additional 652 bridges are scheduled for replacement in 1952. There will still remain some 7,000 bridges which are inadequate for present-day loads. Some of the roads must be closed to traffic until bridges can be replaced.

A few more airplane landing fields are planned in or adjacent to national forests to meet fire-control and other special needs. Many of the existing fields need to be improved and extended so that they can safely accommodate the aircraft now being used extensively for fire protection and insect control. Forest Service landing fields are far from elaborate affairs. Usually they consist of little more than a cleared, leveled, and graded strip in the forest, a wind sock, and a telephone. With cooperation of the Civil Aeronautics Administration and some local cooperation, the landing strips are gradually being improved. A few have been given a blacktop surface treatment. A blacktop or concrete surface on at least a portion of a strip reduces the frequency and expense of aircraft-motor overhaul. The dust and dirt that a motor picks up from an unpaved strip during the warming-up period causes high motor maintenance expense.

National-Forest Properties

The national forests and related properties were increased during the fiscal year 1951 by a net of 276,449 acres. This increase extended the area of these properties to 181,034,882 net acres out of a total gross area of 229,257,719 acres within their defined limits. The properties included the 151 national forests, 33 purchase units established with the approval of the National Forest Reservation Commission pursuant to the Weeks law, 16 experimental areas, and 9 land-utiliza-

tion projects currently under the administration of the Forest Service.

An additional 92,000 acres acquired by the United States for rural rehabilitation purposes were administered by the Forest Service during the fiscal year. The Forest Service also served as custodian of the Federal interests in 445,889 acres of land-utilization-project lands which the several States are managing for forestry and related purposes under lease and cooperative agreements.

Boundary Changes and Readjustments

Two minor boundary changes were effected during the fiscal year. Public Land Order 707, dated March 16, 1951, extended the boundaries of the Ouachita National Forest in Arkansas to include 4,866 acres of privately owned lands which are suitable for acquisition for timber production and watershed protection; and 4,171 acres of private land not considered desirable for national-forest purposes were eliminated from the forest boundaries by the same order. Public Land Order 721 of May 2, 1951, excluded 8,186 acres, all but 2 acres of which were privately owned, from the Olympic National Forest in Washington.

Land Purchases

Further consolidation of Federal ownership in 26 national forests and purchase units was accomplished during fiscal year 1951 through approval by the National Forest Reservation Commission of the purchase of 180 tracts involving 24,430 acres. This included 16,183 acres situated within 22 purchase units previously established under the Weeks law. These purchases will aid in consolidation of the units and promote timber production and conservation of watersheds. Control of soil erosion and flood damage will be aided by the acquisition under authority of certain forest-receipts acts of 2,934 acres contained in eight tracts approved for purchase during the year in four national forests in California, Utah, and Nevada. Purchase of 43 tracts containing 5,313 acres of privately owned land in the Superior National Forest, as authorized by Public Law 733 of the Eightieth Congress, was approved during the year to facilitate the efforts of the Forest Service to preserve the primitive environment of the Superior Roadless Area.

Forest Exchanges

Applications for the exchange of 178 tracts of privately owned, county, or State lands within or near the national forests for national-forest lands or timber, or land-utilization-project lands, were reviewed and approved during the fiscal year; 199 exchange cases were consummated and the Government accepted title to 299,698 acres of land within or adjacent to national forests. The Government granted or will grant in exchange for such land 95,838 acres of national-forest or land-utilization-project lands and cutting rights to 205,691,000 board feet, more or less, of national-forest timber.

Miscellaneous Acquisitions and Disposals

Eight tracts involving 332 acres were donated to the Government for national-forest purposes. Two of these tracts, including about 7 acres, were primarily for administrative sites and the balance are

suitable for timber production and other national-forest purposes. Twenty-two tracts were purchased pursuant to the act of March 3, 1925, as amended, for sites for ranger stations or other administrative facilities, or as additions to existing sites.

One tract comprising 22 acres was conveyed pursuant to section 16 of the Federal Airport Act, and 25 small sites, each of 5 acres or less, occupied as homes by residents of Alaska, were eliminated from the Chugach and Tongass National Forests so the occupants may obtain land patents.

Continued consolidation of national-forest units to promote more effective and economical watershed protection and to assure restoration and perpetuation of the soil, timber, recreation, water, and other resources is essential. Pressures on our remaining resources are continually growing, and the need to build up renewable resources and conserve those that exist becomes more imperative as the demands upon them increase.

There is particular need to acquire those intermingled private lands within the national-forest boundaries that are especially significant from the standpoint of fire protection, sustained timber yield, or flood and erosion prevention, or which cause undue administrative expense. Acquisition of these "key" tracts will not only simplify management and promote conservation but will act to protect the public investment in the surrounding national-forest lands. A moderate land-purchase program looking especially to such tracts is considered fully justified during the emergency period.

COOPERATION IN STATE AND PRIVATE FORESTRY

States and private owners of forest land receive cooperation from the Forest Service in the application of sound forest-management practices, in the maintenance of organized protection of forest lands against fire, and in the production and distribution of planting stocks for windbreaks, shelterbelts, and farm woodlands. The Forest Service also administers the agricultural conservation program of the Production and Marketing Administration as applied to the naval stores industry.

Federal cooperative assistance in the prevention and suppression of forest fires on State and privately owned forest lands is continuing, under authorization of the Clarke-McNary Act, in 43 States and Hawaii. This work is reviewed in connection with the discussion of forest-fire protection earlier in this report.

Forest Management Assistance to Woodland Owners

On July 1, 1951, the Cooperative Forest Management Act of 1950 became effective. It replaces the Norris-Doxey Cooperative Farm Forestry Act under which the Federal Government has cooperated with State forestry agencies for more than a decade in providing technical assistance to farm owners in the management of their woodlands and in the utilization and marketing of their products.

The activities of the Norris-Doxey farm or project foresters were broadened to cover technical assistance to small sawmill operators and other processors of primary forest products. Furthermore, all privately owned forests, farm or nonfarm, are made eligible for management advice and assistance.

In the work carried on under the new Cooperative Forest Management Act, attention will be given primarily to the 4¼ million small owners of forest lands. These farmers and nonfarm owners, whose forest-land holdings average only 62 acres each, are the ones most in need of the service. The Cooperative Forest Management Service foresters will continue to provide technical advice and assistance along such lines as making simple forest-management plans; marking trees to be cut; estimating timber volume; determining proper cutting methods; marketing forest products; and planting, thinning, pruning, and protecting against fire, insects, and diseases.

In fiscal year 1951 some 240 project foresters aided 4,718 woodland owners in 38 cooperating States. They were responsible for improved forest-management practices on 2,558,091 acres of forest land. The woodland owners received nearly \$16,000,000 in cash through harvesting and sale of over 721 million board feet of saw timber and other forest products, including 1,449 barrels of gum naval stores, 189,273 gallons of maple sirup, holly, Christmas trees, tree seed, pine cones, and other miscellaneous products.

The project foresters were unable to fill all requests received, and at the end of the year, more than 4,700 requests for assistance remained unfilled. Only about one-half of the area needing this kind of assistance now has it. Also, in some States the existing project areas are too large to permit adequate coverage of the forest properties in need of technical forest-management assistance.

Farm Forestry Extension

Educational work in farm forestry is conducted by the State agricultural extension services of the land-grant colleges, in cooperation with the Department of Agriculture's Extension Service, and with the Forest Service as the subject-matter agency. Forty-five States and one Territory now employ one or more extension foresters. Other Federal, State, and private agencies are brought into the picture to make the program as effective as possible.

Farm forestry extension is a program of nonresident instruction carried on through leaflets, bulletins, circular letters, information in newspapers and farm journals; method-and-result demonstrations; visual aids such as motion pictures, slides, and fair exhibits; radio and television; and through meetings and other contacts with farm people. The State extension forestry specialists work closely with the county agricultural agents. Topics covered include farm woodland management, utilization of farm woodland products on the farm, marketing of products, timber estimating and appraisal, planting windbreaks and shelterbelts, preservative treatment of farm timbers and fence posts, wildlife management, prevention of farm fires, and production of naval stores and maple sirup.

Important among last year's activities were demonstrations of tree-planting machines for establishment of windbreaks, shelterbelts, and future timber crops. There were also demonstrations in the use of the power saw. This labor-saving device has created a desire on the part of many farmers to do their own logging, and thus has caused them to become interested in log grades, log scaling, potential markets and market prices, and in instituting good cutting practices in their farm woodlands.

Through the 4-H Club program, a special effort is being made to provide rural youth with an understanding and appreciation of forestry. In this work, 167,745 boys and girls last year received training in forestry, and 572,917 in fire and accident prevention.

Cooperation in Tree Planting

The production of trees in State nurseries in fiscal year 1951 again passed all previous records. The output approximated 400 million trees, as compared with 350 million in 1950, 239 million in 1949, 157 million in 1948, and 84 million in 1947. These figures represent a fivefold increase in 5 years and an encouraging advance toward the suggested goal of a billion trees a year. This progress was a remarkable achievement on the part of the landowners, States, and organizations interested in the reforestation of millions of acres of denuded and unproductive forest land.

All but five States are now conducting tree-distribution programs with Federal cooperation under provisions of the Clarke-McNary Act. One of these five conducts a program without Federal cooperation. Two of the States are served to some extent by adjoining States. Four States operate no nurseries but distribute trees which they buy from private and Federal nurseries. Eighty-three nurseries, in all, are operated by the States and Territories. A number of these nurseries are being enlarged and several new ones are planned.

Prior to fiscal year 1951, trees produced under the Federal-State cooperative program could be distributed only to farmers. The States could not receive the benefit of Federal help for production of trees shipped to nonfarm forest landowners. The Eighty-first Congress amended the law, extending Federal aid to cover production and distribution of trees for nonfarm forest planting, and increased the authorization for such work. The increased production in 1951 is at least partly due to this amendment.

Tree planting is receiving active help and encouragement from many agencies and groups, including schools, service clubs, and conservation groups, private citizens, forest industries, and business institutions such as banks, railroads, and chambers of commerce. Their efforts to get more planting done are succeeding so well that the demand for trees still exceeds the supply, despite the 500-percent increase in output during the past 5 years. These interested organizations encourage tree planting in many ways. For example, 4-H Clubs, Future Farmers of America, and other youth groups are giving training in tree planting, and in promoting planting on community project areas or on the home place. Clubs, banks, and business houses are making tree-planting machines available in their localities; industries and soil-conservation districts often give trees to landowners; sportsmen's groups and schools plant tracts of available idle land.

Naval Stores Conservation Program

The Naval Stores Conservation Program, a part of the general agricultural conservation program authorized by the Soil Conservation and Domestic Allotment Act, is administered by the Forest Service for the Production and Marketing Administration. Under the program, payments are made to turpentine farmers who carry out good naval stores and forestry practices in their woods.

The requirements of the program stipulate that no trees are to be cupped below the minimum tree sizes—9, 10, and 11 inches in diameter; selective cupping, patterned on selective cutting, is to be practiced; and only trees previously worked are to be cupped. In addition to these requirements, on which payments are based, all payments take into consideration the care exercised by farmers in preventing and suppressing wildfires and in following good timber-cutting practices.

In 1950, 3,080 naval stores producers, working 51,000,000 trees, participated in the program. This was 35 percent of the total number of producers and 75 percent of the total number of trees worked in the naval stores region.

In addition to checking program compliance, the naval stores conservation program inspectors are actively promoting the use of chemical stimulation to increase gum production. It was largely due to their efforts that the practice of chemical stimulation, followed by 5 percent of the producers on 6 percent of the faces in 1949, was in 1950 followed by 10 percent of the producers on 17 percent of the faces.

RESEARCH

Forest Management

The field of forest-management research encompasses a wide range of subject matter. Research is currently being conducted on many different projects such as planting, stand improvement, genetics, mensuration, cutting methods, and silvics—the study of the habits or behavior of forest trees. Much of the progress from year to year represents advances on the road to solution of major problems, the final answers to which are still not fully known.

Understanding the Forests

Much of the early research in forestry consisted of intensive studies of growth habits of individual trees. As more and more was learned of trees as individuals, they were classified according to their capacity to grow, to produce lumber of high quality, to resist attack from insects and disease, to produce seed or a new crop of trees, and to tolerate varying degrees of shade and competition. The next step naturally would be to study trees growing in groups or communities where conditions of age, density, composition, and site are more or less similar. At the California Forest and Range Experiment Station such a study has resulted in a new understanding of the complex pine forests of that region. These forests, seemingly growing without order or any semblance of uniformity, have been found to be composed of many small divisions in which certain forest conditions are similar. Distinct divisions or units of area representing similar conditions were readily discernible. They varied from one-tenth to several acres in size. Several major forest conditions and many minor variants of these conditions have been identified, described, and classified, making it possible to prescribe precise silvicultural treatments for any condition encountered in the timber-harvesting operation. A sampling procedure designed to determine the total area occupied by each forest-condition class was also developed. This makes it possible, with the aid of growth studies now completed, to compute more precise cutting budgets for sustained-yield management for these forests.

Among the most complex of all forest types to be systematized into a set of forest-condition classes are the bottom-land hardwoods of the South. Eight separate forest types are present, 60 variants occurring within the types that need special silvicultural consideration. This project was completed by the Southern Forest Experiment Station and the results have been made available in a guide for the management of southern bottom-land hardwoods. With 30,000,000 acres of these forests in the South and a potential growth under proper management of more than 7,000,000,000 board feet of excellent timber per year, the value of such information is readily apparent.

In the Southwest the results of 40 years of forest research were summarized in a monograph on ponderosa pine. The publication provides information on cultural procedures, soil and climatic requirements, volume and growth tables necessary to management, and methods of regenerating these forests either artificially or naturally. It discusses also the role of damaging agents such as wind, lightning, fire, rodents, insects, diseases, and browsing animals in the history of these forests. The work represents the lifetime contribution of a forest research worker, but less than one-quarter of the life span of a tree from its beginning to maturity.

Forest management in the tropics involves many unusual and vexing problems. For example, determining the age of trees by the customary technique of counting rings has proved unreliable with tropical trees. An answer to this problem for the virgin rain forest of Puerto Rico at least is now in sight. A new method being developed at the Tropical Forest Experiment Station is based on a mathematical relationship of growth with time.

Renewing Forests

What to plant, when to plant, where to plant, how to plant, how to care for plantations, what enemies to guard against, how to plan large-scale reforestation in the Lake States—these subjects are all covered in a new bulletin based on 20 years of research by the Lake States Forest Experiment Station.

The problem of reforesting the 190,000 acres of strip-mined coal lands in the Midwestern States seems less formidable in the light of an examination by the Central States Station of 26 successful coal-company plantings in Indiana. On moderately acid spoil banks, the growth of hardwood species, planted in mixtures which included black locust, has been good. These trees have grown an average of 1.5 feet in height per year, which compares favorably with the growth of trees in natural forest stands.

Direct seeding after burning or disking has given satisfactory stands of both slash and longleaf pines at Alexandria, La. The burning or disking improves the seedbed, lessens first-year grass competition, and destroys cover which harbors seed-eating rodents. Cheaper reforestation methods are needed for the large acreage of pine forest land in the South that now has no natural pine seed source. The experiments indicate that direct seeding, although vulnerable to drought, rodents, and birds, can be done for little more than one-third the cost of planting nursery-grown trees.

In the northern Rocky Mountains where natural regeneration has been unsuccessful following broadcast burning, direct seeding has been successful on burned areas baited for rodents with thallium sul-

fate-treated sunflower seed. At the end of the first growing season, approximately 75 percent of the experimental seed spots contained one or more seedlings. These results together with previous findings for other species in the same region make it clear that successful direct seeding depends upon (1) absence of seed-destroying rodents, (2) absence of vegetal competition, (3) sites not subject to severe drying, and (4) favorable weather during the first growing season.

The testing of hybrid poplars and the breeding of important native forest trees was accelerated in the Northeast. At Beltsville, Md., the more vigorous hybrid poplars have grown to an average height of more than 12 feet in 2 years from dominant cuttings. On the Hopkins Experimental Forest in Massachusetts, where the growing season is shorter, the average height of the best hybrids exceeds 8 feet in 2 years. In the breeding tests seed was produced satisfactorily from 30 hybrid combinations, including both hardwoods and softwoods.

Evidence continues to point to the superiority in resistance to blister rust of hybrids from crossing American and Asiatic white pines over crosses of American white pines. A back cross—a straight cross followed by a cross between the hybrid and one parent—of Jeffrey pine and Coulter pine has been produced by the Tree Breeding Institute in California that shows a marked capacity to survive in plantations. One of the most remarkable hybrids to be developed at the institute is a three-species hybrid of the three-needled pines (Jeffrey and ponderosa) and the five-needled pine (Apache). It has shown exceptional vigor and the results attained in this cross suggest the possibilities of combining the resistance of Coulter pine to pine reproduction weevil with the rapid growth of still another hybrid. Such a future hybrid might also be resistant to western pine beetle.

Tending Our Forests

Starting new forests where they must be replaced or where they do not now exist calls for special knowledge and special techniques. Making the most of existing forests—in volume of materials produced, in income derived, in protective, recreational and other benefits—is even more important.

The forest manager must strive constantly to maintain trees of favored species in his stands. More and more is being learned of various trees in this respect. Tests during the past 2 years on the Allegheny National Forest have disclosed that black cherry, a valuable tree in Pennsylvania and New York, is dominant in the reproduction following only two types of cutting: (1) Narrow strip cuttings in 40–60-year-old second growth, and (2) small group openings in second growth cut to diameter limits of 8 inches or less.

That proper partial cuttings in hardwood stands reduce mortality losses from wind was illustrated again recently on the Argonne Experimental Forest in Wisconsin. Volume losses on an area partially cut during the spring were only one-seventh those on adjacent uncut stands, when one of the most severe windstorms on record swept the area the following October.

Increasing markets for thinnings has brought an acute need for thinning guides for all important timber species. Such guides are best developed by careful thinning experiments that begin with sapling stands and end with the final harvest of mature timber. Such studies

would require from 50 to 150 years to complete. At the Pacific Northwest Forest Experiment Station, however, a new interim guide has been developed for Douglas-fir. This guide gives the number of trees to which stands of any given average diameter and height should be thinned to obtain optimum yields.

Cutting practices on most small woodlands are poor. In an effort to demonstrate that income at short intervals can be obtained while improving them, a number of small forest areas of 40 acres or so have been dedicated to this purpose on experimental forests throughout the country. While not spectacular, results continue to be encouraging. A reasonable return for labor expended seems possible in most cases even while converting run-down properties to managed forests. On the Massabesic Experimental Forest in Maine, returns for stumpage and labor expended in improvement cuttings on a white pine woodlot were \$1.33 per man-hour. For the past 5 years on a northern hardwood farm woodland "forty" in the Upper Peninsula Experimental Forest in Michigan, returns per man-hour have ranged from \$1.10 to \$1.52 and averaged \$1.31. In tests with pine-hardwood stands in Alabama comparable returns were \$0.80 per man-hour on a poorly stocked tract and \$1.11 on a moderately well-stocked unit.

In the current defense effort, how to use men more productively becomes increasingly important. Effort has been made in forest-management research during the past year to determine ways to conserve manpower in woods operations through improved logging methods. On the Massabesic Experimental Forest in Maine, for example, changing from 2-man to 1-man power saws in felling and bucking white pine trees reduced the time required per thousand feet of logs by 1 to 1½ man-hours. Again, on the Fernow Experimental Forest in West Virginia the use of power saws for felling and bucking, and tree-length logging with tractor-drawn sulky, gave about 25 percent greater production than the use of conventional cross-cut saws and the practice of ground-skidding with teams.

Usable methods of prolonging the flow of gum by sulfuric acid are now available to the naval stores industry as the result of past research. These methods saved the industry about one-half million dollars in 1950. There is need, however, for a chemical safer and easier to use than sulfuric acid. Initial experiments now show that 2,4-D solutions are producing about the same yield of gum as sulfuric acid for the first 2 years in working on slash pine. These preliminary results lend encouragement to the belief that effective but safer chemicals will eventually be available to the industry.

Range Research

Some 950,000,000 acres of range land, largely in the West and South, have a major part in the production of more than half of this country's cattle and calves and three-fourths of the sheep, lambs, and wool. Range research is emphasizing the development of practices that will obtain greater values from the range resource and increase livestock production. The high demand for meat, especially beef, in the defense-emergency period points up the necessity for improving and making more efficient use of the Nation's range lands.

Grazing-management practices have been and are being developed that will maintain ranges now in satisfactory condition and improve

ranges not now producing their maximum in livestock products. On some badly deteriorated western ranges where natural recovery under good management would be extremely slow, research on range reseeding has laid the foundation for quicker range recovery. More than 8,000,000 acres of range lands have been successfully reseeded in the past 15 years as research has pointed the way. Continued research on what, how, when, and where to seed, and how to graze these reseeded stands will bring similar success to other ranges.

Value of Reseeding Shown

Cooperative grazing tests, which have now extended over a number of years, show the value of reseeding depleted range lands to crested wheatgrass. On a 46-acre area at the United States Range Livestock Experiment Station, Miles City, Mont., for example, an average of 80.5 pounds of beef per acre has been produced annually during an average period of 1 cow-month of grazing for the past 11 years under spring and early summer grazing. Rainfall there has averaged 14 inches a year. At the United States Sheep Experiment Station, Dubois, Idaho, with 11 inches average rainfall, seeded crested wheatgrass has for the past 10 years furnished forage on an average 2 weeks earlier than native range plants, and has furnished 5 sheep-months per acre annually of early spring and fall grazing. Near Ephriam, Utah, a range area with about 12 inches precipitation has, for 8 years, provided 5.8 sheep-months per acre annually of spring and fall grazing. Twenty rather large areas of typical reseeded range, totaling 14,000 acres in Idaho, Utah, and Nevada, have furnished from 300 to 1,700 pounds per acre of air-dry herbage. Grazing capacities from these areas have been from 2½ to 10 times greater than comparable adjacent unseeded range. Annual rainfall at these areas varies from 9 to 20 inches, half of them having 12 inches or less each year. On one sagebrush area near Gunnison, Colo., intermediate, pubescent, crested, and tall wheatgrass all yielded over 1 ton of air-dry herbage per acre as compared to 140 pounds for native grass on a comparable adjacent unseeded area.

Among the more favorable sites for range reseeding in the West are those taken over by big sagebrush and now producing very little palatable forage. Considerable breakage and lost crew time resulted when heavy disk plows and other disks designed primarily for cultivated farming operations were used on rough, rocky, range lands. Through research and experimentation, the Forest Service has developed a brushland plow which has removed big sagebrush more effectively with greatly reduced breakage and at about half the previous costs. The plow has paired disks, mounted on an arm with spring tension so that each pair will automatically lift itself over rocks, stumps, and piles of brush without affecting the operation of the other disks and without undue strain on the plow. The brushland plow, although heavier, is operated with less tractive power than farm disks with the same width of cut. This plow, now available for commercial production, will greatly reduce reseeding costs and further encourage improvement on millions of acres of range land throughout the West.

Control of Undesirable Plants

The control of noxious and poisonous plants and undesirable shrubs on range lands is being studied to find out how they can be reduced and replaced with valuable forage plants.

Halogeton, an introduced poisonous plant first found in this country by a Forest Service range researcher near Elko, Nev., in 1934, has now spread to six States, from California to Montana and Wyoming. It is a serious threat to the livestock industry, especially in northern Nevada, southern Idaho, and northern Wyoming. It is a prolific seeder and spreads rapidly. It establishes itself where natural vegetation has been depleted, and is most abundant along trails, roads, and in livestock concentration areas.

Halogeton is extremely poisonous to sheep and cattle. Being a hardy annual, it offers a serious problem of control. However, research on range reseeding has indicated suitable species and adaptable methods for reseeding many areas where halogeton infestation occurs or is likely to occur. Limited studies in Nevada show that the seeding of crested and intermediate wheatgrasses effectively controls halogeton on burned sagebrush ranges. Studies of reseeding of unburned halogeton-infested ranges indicate that established stands of it can be reduced. Unfortunately, halogeton occurs on many dry, saline desert sites where methods for successful reseeding are yet unknown. This poses an urgent and critical research problem.

Mesquite invasions in the Southwest constitute a serious range problem. Mesquite now occurs on some 70 million acres and is continuing to spread and thicken in abundance wherever it secures a foothold, often in the choicest grassland areas. A report is now being prepared on the results of some 10 years experimentation in control of velvet mesquite in Arizona. Well-established but light stands of mesquite, exceeding 15 plants per acre, where roots extend out as far as 30 feet from each plant, offer serious competition to grass for soil moisture, cause a reduction in the grass stand, and adversely affect forage yields. This is especially true on drier range areas. Density and yield of the perennial range forage grasses were double that of untreated range within 3 years following the killing of mesquite. Control on light to moderate stands of mesquite is practical with Diesel oil or sodium arsenite. Costs for chemical and labor have averaged about 4 cents per plant. These control costs, even with as many as 100 plants per acre, could generally be liquidated in 9 or 10 years by the increased range-forage and livestock production.

Cattle and Deer

In Utah, a cooperative study, begun in 1947 by the Forest Service, Fish and Wildlife Service, Utah State Fish and Game Department, and Utah State Agricultural College, of the interrelation of game and livestock grazing is yielding some enlightening results. The relative grazing or browsing pressure of cattle and deer on common summer range has been measured on 10 major vegetal types.

Areas heavily grazed by cattle are also heavily used by deer—a fact which creates a serious management problem. One notable exception is the oak-sage type. Although competition is close on slopes less than 25 percent, steeper slopes curtail cattle utilization and such areas are left mainly to the nimbler deer. In general, the steep topography restricts cattle to only 52 percent of the summer range as compared with 92 percent for deer, on the area studied.

The study also emphasizes the need for balancing deer numbers with available forage. Winter deer mortality on a fair-condition

range which was conservatively stocked amounted to 9.5 percent. On severely depleted and heavily overstocked range the loss was 41.6 percent.

Measuring Trends

The 3-year study to develop a method for measuring trend in range condition of national-forest ranges has been completed. It provides a definite measurement of a series of 100-foot permanently located transect lines on which are recorded vegetation, bare soil, erosion pavement, rock, and litter, together with a preliminary classification of current range condition and trend. By periodic future remeasurement of the transect lines which are established in the usable parts of the range, a reasonably reliable estimate can be made of improving or declining forage condition and erosion hazard.

In the spring of 1951 plans were completed and personnel assigned to an intensive study of grazing management on several range units of the Bighorn National Forest. The studies are being conducted in cooperation with the University of Wyoming and interested stockmen.

Forest Influences

That water is a key to national progress has penetrated the public consciousness more completely than ever before. There is now a sounder appreciation of the fact that water troubles are closely associated with the condition and use of the land. Much of this enlarged public understanding has come about through the findings of influences research. Such research, together with the special hydrologic investigations undertaken under the Department of Agriculture's watershed flood control survey program, has expanded our basic knowledge of the principles that govern watershed behavior and has developed for specific areas the close interrelations of soil, plants, and water.

Influences studies at 14 Forest Service research centers are making substantial progress in ferreting out the complex factors that affect the hydrologic characteristics of soils and the yield, behavior, and quality of surface and ground waters. It can now be affirmed that the character and condition of the soil mantle—a product of natural forces and human activities—provide an important clue to the control and conservation of water as it enters the channels of large and small watercourses.

Watershed problems everywhere have the same basic elements, and their solutions require the same basic techniques. Nevertheless, the wide variations in climate, soil, topography, vegetation, and use from region to region call for the adaptation of research methods to specific regional needs. These regional differences are reflected in the variety of problems considered, and the correspondingly varied approaches applied by the several influences research centers.

Evidence of Fire's Effects

A sequence of fire, denudation, and heavy rainfall on two chaparral watersheds in southern California provide further clear-cut evidence of the disastrous consequences of exposing soil. Two days after a 633-acre fire on July 4, 1950, a storm producing about three-fourths

of an inch of rain struck the area. Within half an hour, flows of mud and boulders surged from the watershed. The swift debris flows threatened the lives of returning fire fighters. They caused several thousand dollars damage. Severe soil washing—at the rate of 49,000 cubic yards per square mile in one area—exposed bedrock on the higher slopes. No debris emanated from the adjacent unburned, well-vegetated canyons, despite their exposure to the same storm.

Steps must be taken immediately to revegetate such scorched soils if the possibilities of disaster are to be reduced. Tests with 26 different soil stabilizing plants during the past 2 years reveal 2 species that meet this need effectively. Black mustard, which has long been used for the purpose in southern California, rated the best. Sown on freshly burned areas, it has produced stands of satisfactory density on over 70 percent of the area. Annual ryegrass has also proved durable and effective, although it does not spread as well as other plants.

In the Southwest, extensive areas of granitic soils that had once been overgrazed continue to furnish destructive sediments to reservoirs and channels. It was previously thought that long-continued protection from heavy grazing would permit the vegetative cover to improve sufficiently to control excessive erosion. This view has proved overoptimistic. Large areas have still not recovered after 22 years without grazing. Obviously more than this is needed. What kinds of measures will be most effective, and how quickly and cheaply they can be applied, poses a provocative problem for further scientific inquiry.

“Operation Snow Pack”

The abnormally large snow pack on the headwaters of the Columbia in 1950-51 provided an unusual opportunity to measure and observe snow and its runoff under different cover conditions. An “Operation Snow Pack” was organized to capitalize on this situation. Three two-man parties spent 6 weeks in the field systematically studying the relation of plant cover to snow accumulation and melt. Supplies were delivered to isolated parties by parachute, and communication was maintained by short-wave radio. The preliminary findings showed that: Brush had little effect on snow accumulation or melt; heavily forested areas accumulated less snow than open areas, but snow-melt rates were slower under timber than on grass or cut-over areas; more snow tended to accumulate in patchy clumps of timber than on open areas.

Further south in the Rockies, studies were continued on the factors that affect water quality. A major problem here is how to utilize timber and forage on the watersheds and yet maintain or improve the quality of stream flow for water supply and other purposes. The answer lies in keeping the soil out of the streams. Different types of cover vary significantly in their soil-water protective value. The development of a rapid and inexpensive method of determining quantitatively the relationships between cover types and soil-water protection is one of the fruitful byproducts of the investigations during the past year. Forest research workers designed a “Rocky Mountain Infiltrimeter,” a portable device for applying controlled amounts and intensities of rainfall to small plots covered with various types and densities of vegetation, and for measuring the subsequent rates of runoff

and erosion. A similar device has been used to determine the soil-protection needs of the mountain range lands of the Intermountain region in Utah. Analysis of data from such studies indicates that, as a general rule, surface runoff and soil-loss rates can be maintained below the danger point (runoff of less than 5 percent per storm) where at least two-thirds of the ground surface is sheltered by vegetation and its litter.

Flood Sources

In the northeastern United States, where the snowpack is frequently less than 2 feet deep, past flood-control investigations have indicated that soil freezing often has a significant effect on the size of winter and early spring floods. Soil freezing reduces the infiltration of water from melting snow or spring rains. The duration, extent, and type of frost appear directly related to the type, density, and condition of the vegetal cover and soil characteristics. In general, the denser the cover, the less will be the extent of frost and the more porous its character. Intensive field and laboratory studies are under way at six locations in New England, New York, and Pennsylvania to determine these relations more precisely as a basis for predicting the effects of various watershed flood-control measures in this region.

Studies of the effects of uncontrolled logging, fire, grazing, etc., on sensitive mountain terrain indicate that relatively small unstable areas can become sources of excessive flood and sediment damages. For example, in the Shenandoah Mountains of Virginia and West Virginia and other parts of the Southern Appalachian Mountain region, long-continued farm and forest practices have cumulatively lowered the stability of steep mountain slopes to the point where severe soil and rock slides follow the heavier storms, depositing large amounts of debris on valley farms and settlements. Intensive research is needed to develop systematic methods for identifying such potential flood-debris source areas and exempting them from logging, road-building, and other practices which, according to scientific investigations, contribute to their instability.

Other lines of research offer promise in achieving increased water yields. At the Coweeta Experimental Forest in North Carolina sulfur dioxide was employed to defoliate stream-bank vegetation as a means of reducing transpiration to obtain a temporary increase in stream flow.

Assistance on Watershed Problems

Substantial assistance on watershed-management problems was provided during the year to Federal, State, and local agencies. Among these activities was an initial exploration of New York City's watersheds, requested by city officials, resulting in recommendations for the development of policies and practices conducive to increased yields of high-quality water. The Forest Service also participated in water-conservation activities of the cities of Los Angeles and Glendora, Calif., and of the Interstate Commission on the Potomac River Basin. Assistance was given to the President's Water Resources Policy Commission in preparing its reports on national water policy, and to the technical activities of the Hydrologic and Sedimentation Subcommittees of the Federal Inter-Agency River Basin Committee.

Forest Economics

Comprehensive and reliable facts about the Nation's timber resources, the use of timber products by different industries, and future requirements for various forest products are becoming more and more necessary in planning for full-scale timber production and for adequate future timber supplies. The collection and interpretation of these basic facts constitute important phases of the Forest Survey, authorized by the McSweeney-McNary Act of 1928.

During fiscal year 1951 field inventory work for the national survey of forest resources covered about 14 million acres of previously unsurveyed forest lands in California, Idaho, Kentucky, Indiana, New York, Pennsylvania, Maryland, and Tennessee. In addition, about 19 million acres of forest land, initially inventoried in the 1930's in Washington, north Idaho, Minnesota, Wisconsin, Michigan, Arkansas, Georgia, and Florida, were resurveyed to bring the original information up to date. In 14 of these States substantial financial or other assistance was contributed by cooperating public and private agencies. Analytical forest-resource reports for the States of South Carolina and Mississippi were completed, and a report was issued for the Lake States. Statistical reports were issued for Montana, Florida, and parts of Tennessee, Kentucky, Minnesota, Oregon, and California.

Since the Forest Survey was begun in 1930 about two-thirds of the 620 million acres of forest land in continental United States have been covered by initial surveys. About 120 million acres of forest land initially covered prior to 1940 also have been resurveyed.

Surveys of the use of forest products by railroads, in fabricated articles, in shipping agricultural and industrial products, and in farm construction have been under way as a basis for estimating future needs. A survey of wood used in manufacture in 1948, covering 92,000 manufacturing plants in 190 industries, was completed during the year. The results showed that the equivalent of nearly 14 billion board-feet of lumber, veneer, and plywood was used in manufactured products. The greatest amounts were used for containers (34 percent), millwork (16 percent), furniture (16 percent), flooring (8 percent), and construction and repair of railroad cars (3 percent). Six kinds of wood made up about two-thirds of the total volume, including 2.4 billion board-feet of ponderosa pine, 1.8 billion feet of southern yellow pine, 1.4 billion feet of Douglas-fir, 1.3 billion feet of oak, 1.2 billion feet of sweetgum, and 0.7 billion feet of yellow-poplar.

Special Economic Investigations and Reports

Plans of defense agencies for sustaining production of lumber, plywood, wood pulp, and the many other wood products have greatly accentuated needs for information on many strategic timber resources and available supplies and requirements for timber products needed by the military and other essential users. A variety of special investigations made by the Forest Service have resulted, for example, in: (1) Reports for the National Security Resources Board and the President's Materials Policy Commission on production, imports, stocks, and consumption of the various forest products and the probable quantities that will be required in the future to meet demands at assumed levels of general economic activity; (2) reports to the President's Materials Policy Commission on long-range requirements and

supplies of forest products; (3) a report in cooperation with the Economic Commission for Europe on trends in timber production, consumption, and foreign trade of the United States in the most important forest products; and (4) reports on foreign forestry and international trade consisting of appraisals of the adequacy of forest resources and forest industries in foreign countries, especially those of strategic and critical importance, and impacts upon balancing the timber budget of the United States.

Special reports reviewing raw-material supplies, and other production problems were prepared for the National Production Authority to provide background information for passing on prospective loan and tax applications from manufacturers of pulp and paper, lumber, veneer and plywood, wooden pallets, and other products. Reports on supplies and requirements for cork and tannin extract, including an appraisal of possible domestic substitutes to relieve dependency on foreign supplies, also were prepared for defense agencies.

Military use of lumber and other forest products during World War II, military procurement of timber products by the Central Procurement Agency, and an analysis of procurement problems, were the subjects of investigations made by the Forest Service for the Corps of Engineers. These studies indicated that about 70 billion board feet of lumber was consumed for military purposes during the last war, of which 30 percent was used directly by war agencies. The remainder was used by civilian firms and contractors for the construction, fabrication, and shipping of war-contract items. Military lumber consumption amounted to 38 percent of total United States consumption for the war period.

Another national defense project started during the year as a service to the National Production Authority and other defense agencies, involves a survey of equipment, supplies, and manpower used by primary forest-products industries in the several forest regions of the United States as a basis for estimating wartime needs. Industries covered include sawmills, veneer mills, pulpwood operations, pole and piling concentrators, mine-timber supplies, wood-chemical plants, and miscellaneous bolt-using industries.

Studies in the marketing of forest products have included the testing of hardwood log grades developed by the Forest Products Laboratory to determine their applicability for price reporting and the guidance of log buyers and sellers. Timber buyers' directories have been prepared with the object of bringing buyers and sellers of timber and logs closer together.

Forest Products

Research directed toward the more complete and efficient utilization of forest products and the development of new products is centered at the Forest Products Laboratory, maintained by the Forest Service at Madison, Wis. An account of some of the year's activities follows.

Pruning for Clear Lumber

Artificially pruned Douglas-fir trees begin to produce clear lumber in about one-tenth the time required by trees on which the lower branches are left to die and drop off naturally, it was found in pruning investigations conducted by the Laboratory in the Pacific Northwest.

Branch stubs persist as knots for as long as a century in unpruned trees, whereas artificially pruned branches of second-growth trees 30 to 50 years old healed over in about 10 years and from then on clear lumber was formed. The investigation gave no evidence that pruning left wounds that were infected by decay fungi. Fast-growing trees, as would be expected, healed over more rapidly than did slow-growing trees.

Sandwich Design for Aircraft and Guided Missiles

The Laboratory's research concerning the strength of plywood and its successful development of design criteria for this complex material has brought requests from the military services for similar work in the field of sandwich construction. Sandwich construction consists of facings of strong, dense materials separated by weak, light cores. This extremely light and rigid material has found many useful applications, among them aircraft and guided missiles. The Laboratory's investigations have led to design criteria and fabrication data for sandwich construction which have been published by the Armed Forces.

New House-Sheathing Method

A method of sheathing house walls was developed that meets Federal Housing Administration design requirements for stiffness and strength of walls. Sheathing strips nailed diagonally across studding were spaced about 2 feet apart, and vertical siding was nailed directly to them. Wall sections thus built with studs spaced 24 inches on center (conventional practice calls for 16 inches) were tested and found amply strong. In a house with 1,000 square feet of floor area, such spacing of sheathing boards saves 80 percent on sheathing lumber, or about 1,000 board feet. In addition, about 35 pounds of nails are saved, not to mention the added economy of greater stud spacing and possible saving in construction time.

Pulping Mixed Species Practical

Results of a series of pulping experiments with various species in mixture showed that it is not always necessary to segregate species for pulping. Contrary to long-held beliefs of the industry, different species can be pulped together, provided due consideration is given to the pulping characteristics of the individual species, particularly their chemical composition and their density. Good results were obtained in the cold caustic soda pulping of mixtures of some 20 east Texas hardwoods together with some southern pines. Other successful semi-chemical pulping experiments have included runs with nine eastern hardwoods, including cherry, birch, maple, oak, ash, and beech; several white oaks; several hickories; various proportions of jack pine and aspen; and mixtures of tupelo, yellow-poplar, and maple. The tests indicate the feasibility of using woods-run pulpwood without the usual sorting of species.

Lumber Grades for Military Boxes

The most economical grades of five species of lumber widely used for boxes were determined for the Corps of Engineers, Department of the Army. The tests showed that, without exception, the most economical box was made from the lowest grade of lumber, despite

the longer time required to make it and the greater amount of waste in the lower grades. The investigation was based on actual labor costs and fabricating methods at a large military installation. Results of the investigation are expected to be used by the Corps of Engineers in the purchase of box lumber for the Armed Forces.

Low-Cost Veneer Flooring

A method of drying veneer to produce flexible, flat sheets with low shrinking and swelling properties was developed that makes possible a new approach to the problem of using wood finish floors directly on concrete slabs. Such floors are becoming increasingly popular in low-cost basementless houses. The veneer is dried, green from the lathe, in a hot press equipped with special cauls that grip it sufficiently to eliminate virtually all lateral shrinkage during drying. Subsequent swelling and shrinking are also less than for normally dried veneer. The hot platens dry $\frac{1}{8}$ -inch veneer in about 10 minutes, or more rapidly than the conventional veneer dryers. One face of the veneer remains smooth and takes on a natural dull gloss during the drying process so that little if any further finishing is necessary other than conventional floor sealer. Strip flooring of $\frac{1}{8}$ -inch veneer has been laid as an office floor in mastic directly on concrete to determine application characteristics and performance under constant use.

Forest Utilization Service

Established in 1944 and now functioning at 8 of the 11 regional forest experiment stations, the Forest Utilization Service is a connecting link between the Forest Products Laboratory and timber growers and users, including the forest-products industry. The Forest Utilization Service performs an important dual function in the effort to achieve complete and efficient utilization of the forest crop. It analyzes the wood-using problems of the various regions and presents these problems for solution by research; it also brings research results to forest owners, and to the forest-products industries and related interests.

In addition to carrying on most of its normal functions during the past year, the Forest Utilization Service was especially active in field work related to the national-defense activities of the Forest Service.

PERSONNEL

Program activities in the Forest Service are carried on almost entirely by professional employees. Many professions are represented, but, as would be expected, the majority are foresters. Practically all of the professional recruits are appointed from the Civil Service register of eligible candidates for junior forester. It appeared that a more than adequate roster of candidates was available when the 1951 register was established, since more than 1,200 applicants passed the competitive examination in 1950. Since professional forestry schools in the United States conferred 2,321 bachelor degrees, 275 masters degrees, and 29 doctors degrees in 1950, there was a large pool of trained foresters to supply the demand of all other Federal, State, educational, and private employers.

Despite the apparently adequate register of junior forester eligibles, the Forest Service has experienced considerable difficulty in filling its

financed vacancies. Numerous offers of employment were declined, making the recruitment process long and costly. Declinations have been due principally to the fact that eligibles have been able to obtain jobs with other employers who offered beginning salaries higher than the salary rates for comparable work provided in Civil Service Classification Act schedules.

The placement program which has confronted the Forest Service since the end of World War II, and which has resulted in numerous transfers in order to place returning veterans, has been completed, and a normal turn-over situation has been restored. Since the Forest Service is a career service, the normal turn-over among permanent employees is quite low. The Forest Service, however, has lost a number of its experienced foresters and other trained employees who have resigned to accept more lucrative offers from private employers.

Engineers, like foresters, are recruited in the entering professional grade. Industry has absorbed most recent graduates of engineering schools, with offers of salaries in excess of the \$3,100 per annum which is the rate paid Government workers in comparable assignments. As a result, the Forest Service has been unable to employ the full number of junior engineers needed.

Training and Development

Orientation-training camps for newer technical employees were resumed on a wider scale during the past year, after a 2-year period during which lessened recruitment made it impracticable to hold many such camps.

In one region "traveling" training sessions were held for some rangers and national-forest staff personnel, to give more comprehensive on-the-ground training, mostly in resource management, than would be possible in one limited training camp locality.

In cooperation with the Civil Service Commission, tests designed to indicate executive and administrative capacity were given to some 200 administrative and line employees. The test results showed a reasonably close correlation with multiple appraisals of those tested.

Awards

Two members of the Forest Service received the Department of Agriculture's Distinguished Service Award in 1951. The Department's award for superior service was given to 11 Forest Service men and women. These awards were in recognition of exceptionally meritorious service and accomplishment, and, in one case, of courageous action that saved human lives in a forest fire.

The Forest Service awarded meritorious promotions to 39 of its employees in recognition of unusual initiative and accomplishment on the job. Ten employees received cash awards for valuable employee suggestions. Recognition was given to 14 employees who had completed 40 years of service.

Retirements

During the year, 90 Forest Service employees retired for age or by option, with an average Government service of 36.1 years and an average age of 63.2 years. An additional 51 employees retired because of disability, with an average Government service of 18.31 and an average age of 54.5 years.

Foreign Visitors

The Forest Service had a number of foreign visitors during the year who came to the United States for information or training in forestry.

The largest group of visitors included some 40 foreign nationals, from more than 20 countries, who arrived for a 6-week study tour of forest fire control in the United States starting early in September 1951. The tour was sponsored jointly by the Economic Cooperation Administration and the United Nations Food and Agriculture Organization. The Forest Service assumed responsibility for preparation of the agenda and supervision of the study tour which consisted of a demonstration and training course in all phases of fire control.

STATEMENT OF RECEIPTS AND EXPENDITURES

National Forests

Receipts from the national forests deposited to Forest Reserve Fund amounted to \$56,147,342. In addition \$1,266,898 was collected from revested Oregon and California Railroad Co. grant lands and \$146,049 from Tongass National Forest in Alaska, both of which were deposited in suspense pending proper disposition, making a total of \$57,560,289. Of the Forest Reserve Fund receipts, \$51,098,565 was from timber, \$4,165,574 from grazing, and \$883,203 from special land uses, water power, etc. Of the amount credited initially to the Forest Reserve Fund, \$107,294 is returned to Arizona and New Mexico on account of State school lands within national forests; \$138,996 has been appropriated for acquisition of national-forest lands, and \$4,943 is derived from designated lands in the Superior National Forest, for which special payment is made to the State in lieu of the usual 25 percent. Of the remaining \$55,896,109, 25 percent or \$13,974,027 is paid to States for the benefit of public schools and public roads of the counties in which national forests are situated (subject to possible deduction of not more than \$233,333 to meet the matching requirements of the Cooperative Range Improvement Appropriation); also 10 percent of the same base amount and of the \$4,943, or \$5,590,105, is appropriated to the Forest Service for roads and trails within national forests. From the remaining balance there is appropriated \$44,810 for payment to Minnesota on account of the designated area in the Superior National Forest and \$700,000 from grazing receipts of various national forests for range improvements on such forests.

Expenditures for national-forest operation, protection, and management were \$38,518,573. Additional expenditures from appropriations for forest roads and trails amounted to \$16,047,533 and for acquisition of national-forest land \$389,384.

Aid to States

Forest Service expenditures for cooperation with States and private agencies in fire control, planting, and assistance in forest practice were \$10,634,618.

Research and Miscellaneous

Expenditures for forest research were \$5,089,420; for flood control \$1,680,751; general administrative expense \$648,728.

A total of \$5,891,388 was also expended for fire control, slash disposal, improvement work, timber-stand improvement, and other work financed by outside agencies and from receipts authorized to be expended for specified purposes.

Services for other Government agencies from funds advanced or transferred by such agencies amounted to \$1,470,646, including \$130,233 for the Department of the Interior, \$608,378 for the Army, \$158,952 for the Navy, \$140,499 for the Housing and Home Finance Agency, \$122,673 for the Production and Marketing Administration (Agriculture), \$164,326 for Defense Production (Executive Office of the President), and \$145,585 for other agencies.

Total net expenditures were \$80,371,041. In addition, expenditures for which appropriations were reimbursed amounted to \$4,950,835 and expenditures from proceeds of sale of parts and equipment purchased in prior years \$449,225. Expenditures were accounted for by objective and functional classifications under 116 separate appropriation titles.

The Forest Service handled the naval stores conservation program, involving payment of \$408,738 from funds of the Production and Marketing Administration.

REPORT OF THE CHIEF OF THE FOREST SERVICE

1951

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Table 1. - AREAS WITHIN NATIONAL FORESTS AND OTHER
PROJECTS ADMINISTERED BY THE FOREST SER-
VICE, JUNE 30, 1951

States	Gross area Within Established Boundaries	Part of Gross ^{a/} Area Under Forest Service Administration
	Acres	Acres
Alabama	2,435,748	620,728
Arizona	12,159,651	11,484,933
Arkansas	3,596,744	2,358,966
California	25,078,622	19,938,001
Colorado	15,232,996	13,726,689
Florida	1,241,956	1,074,472
Georgia	1,732,322	663,008
Idaho	21,569,926	20,271,073
Illinois	812,654	220,823
Indiana	784,647	112,686
Iowa	218,671	4,749
Kentucky	1,411,699	457,187
Louisiana	1,274,977	560,565
Maine	878,283	49,128
Maryland	4,318	1,110
Massachusetts	1,651	1,651
Michigan	5,189,082	2,550,679
Minnesota	5,041,324	2,670,829
Mississippi	2,777,325	1,048,456
Missouri	3,459,999	1,352,851
Montana	19,012,815	16,541,003
Nebraska	207,209	206,028
Nevada	5,376,578	5,055,384
New Hampshire	802,714	677,161
New Mexico	10,268,877	8,953,344
North Carolina	3,592,736	1,106,038
North Dakota	764,425	520
Ohio	1,466,029	103,566
Oklahoma	344,269	180,717
Oregon	17,377,168	14,817,479
Pennsylvania	729,119	471,757
South Carolina	1,423,339	586,862
South Dakota	1,403,197	1,115,246
Tennessee	1,531,797	583,640
Texas	1,716,964	658,039
Utah	9,009,454	7,877,461
Vermont	629,004	221,495
Virginia	4,017,962	1,442,139
Washington	10,744,789	9,682,664
West Virginia	1,832,868	903,328
Wisconsin	2,019,698	1,457,649
Wyoming	<u>9,016,134</u>	<u>8,566,663</u>
Total - States . . .	208,189,740	160,376,767
Territories		
Alaska	20,881,797	20,845,566
Puerto Rico	<u>186,182</u>	<u>33,116</u>
Total - Territories	21,067,979	20,878,682
Grand Total	229,257,719	181,255,449

^{a/} Includes land utilization projects and other special areas administered by the Forest Service, and 220,567 acres in the process of acquisition for national forest purposes. Does not include 91,800 acres of New Mexico Rural Rehabilitation Corporation land; 445,889 acres of land utilization project land under Forest Service custodianship but leased to states or state agencies, or administrative sites outside national forest boundaries reserved from the public domain.

Table 2a. - CONSTRUCTION, RECONSTRUCTION, AND MAINTENANCE OF NATIONAL FOREST-ROADS AND TRAILS, BY STATES
Fiscal Year 1951

States	Roads					Trails					Total Expenditures
	Miles		Expenditures			Miles		Expenditures			
	Construction and Recon- struction	Mainten- ance	Construction and Recon- struction	Maintenance	Cost	Construction and Recon- struction	Mainten- ance	Construction and Recon- struction	Maintenance	Cost	
	Miles	Miles	Dollars	Dollars	Dollars	Miles	Miles	Dollars	Dollars	Dollars	Dollars
Alabama	4.6	460	18,830	72,955	91,785	..	..	..	..	..	91,785
Alaska	4.7	53	58,743	68,692	127,435	2	432	13,988	41,433	55,421	182,856
Arizona	37.9	2,998	347,738	208,475	556,213	1	833	374	15,986	16,360	572,573
Arkansas	6.0	2,077	58,098	188,437	246,535	..	..	..	..	..	246,535
California . . .	34.5	10,042	1,310,886	1,045,986	2,356,872	65	6,254	105,829	247,270	353,099	2,709,971
Colorado	46.5	2,226	265,780	290,870	556,650	45	7,893	37,927	55,769	93,696	650,346
Florida	18.8	916	18,912	114,624	133,536	..	..	..	..	..	133,536
Georgia	2.5	492	25,103	76,253	101,356	..	123	..	1,262	1,262	102,618
Idaho	36.1	10,823	411,751	634,485	1,046,236	58	15,064	82,248	262,777	345,025	1,391,261
Illinois	.6	272	67	99,920	99,987	..	..	..	309	309	100,296
Indiana	.2	11	4,079	1,888	5,967	..	..	..	1	1	5,968
Iowa	..	..	..	..	..	..	..	..	..	..	..
Kansas	..	..	..	..	..	..	..	..	..	..	..
Kentucky	.6	185	10,906	66,589	77,495	..	..	..	..	..	77,495
Louisiana	12.2	462	11,252	98,271	109,523	..	..	..	..	..	109,523
Maine	.4	12	3,415	5,220	8,635	4	61	..	1,142	1,142	9,777
Maryland	..	..	..	..	..	..	..	..	..	..	..
Michigan	7.0	1,526	29,144	204,857	234,001	..	..	..	405	405	234,406
Minnesota	6.0	1,158	29,289	115,378	144,667	4	96	194	10,674	10,868	155,535
Mississippi . . .	9.2	732	25,990	196,433	222,423	..	..	..	..	..	222,423
Missouri	.2	986	973	132,523	133,496	..	..	..	328	328	133,824
Montana	15.3	3,796	475,589	426,070	901,659	5	11,116	16,516	321,530	338,046	1,239,705
Nebraska	..	250	51	6,156	6,207	..	..	..	..	..	6,207
Nevada	20.8	412	12,964	50,405	63,369	..	316	2,320	4,977	7,297	70,666
New Hampshire . .	.8	89	77,865	29,150	107,015	3	726	4	10,958	10,962	117,977
New Jersey . . .	..	..	..	..	..	..	..	..	..	..	..
New Mexico . . .	30.2	2,776	137,144	195,660	332,804	..	1,183	2,374	21,019	23,393	356,197
New York	..	..	..	..	..	..	..	..	..	..	..
North Carolina . .	5.6	549	87,807	155,438	243,245	..	390	..	3,899	3,899	247,144
North Dakota . .	..	..	..	..	..	..	..	..	..	..	..
Ohio	.1	14	392	3,120	3,512	..	..	..	2	2	3,514
Oklahoma	..	187	1,860	16,066	17,935	..	..	..	..	..	17,935
Oregon	57.9	9,425	1,029,255	865,794	1,895,049	14	7,304	20,502	168,535	189,037	2,084,086
Pennsylvania . .	3.5	188	7,023	36,951	43,974	..	60	..	634	634	44,608
Puerto Rico . . .	1.3	22	35,269	14,310	49,579	..	31	..	2,183	2,183	51,762
South Carolina . .	15.8	549	2,572	93,318	95,890	..	..	..	..	..	95,890
South Dakota . .	..	1,124	16,906	124,438	141,344	..	3	..	95	95	141,439
Tennessee	..	545	33,232	95,901	129,133	..	270	254	2,388	2,642	131,775
Texas	27.1	766	54,876	124,994	179,870	..	..	..	..	..	179,870
Utah	49.1	2,066	49,778	204,333	254,111	..	2,824	6,400	26,211	32,611	286,722
Vermont	2.5	77	18,204	38,068	56,272	7	139	1,814	7,580	9,394	65,666
Virginia	3.4	501	23,376	114,273	137,649	7	77	2,584	4,906	7,490	145,139
Washington . . .	22.1	2,909	469,735	364,902	834,637	62	6,253	35,990	240,053	276,043	1,110,680
West Virginia . .	2.5	564	26,593	79,831	106,424	..	281	..	3,358	3,358	109,782
Wisconsin	1.0	965	31,286	103,806	135,092	..	..	..	330	330	135,422
Wyoming	17.5	873	55,507	134,133	189,640	23	4,047	10,682	21,009	31,691	221,331
Total	504.5	64,078	5,278,249	6,898,973	12,177,222	300	65,776	340,000	1,477,023	1,817,023	13,994,245

Table 2b. - CLASSIFICATION OF MILEAGE IN FOREST ROAD AND TRAIL SYSTEM, AND EXPENDITURES REQUIRED TO COMPLETE THE SYSTEM TO A SATISFACTORY STANDARD, JUNE 30, 1951.

Class	Total	Satisfactory Standard	Unsatisfactory Standard	Nonexisting	Expenditure Required to Complete
	Miles	Miles	Miles	Miles	Dollars
Forest Development Roads	147,311	53,572	57,684	36,055	747,456,923
Trails	138,711	93,915	35,295	9,501	13,650,009
Total	286,022	147,487	92,979	45,556	761,106,932

Table 3. - QUANTITY AND VALUE OF TIMBER CUT ON THE NATIONAL FORESTS, BY STATES

FISCAL YEAR 1951

STATE	QUANTITY OF TIMBER CUT			VALUE OF TIMBER CUT		
	Sales	Land Exchanges	Total	Sales	Land Exchanges	Total
	MBM	MBM	MBM	Dollars	Dollars	Dollars
Alabama	35,452	..	35,452	390,338	..	390,338
Alaska	60,122	..	60,122	135,039	..	135,039
Arizona	204,212	..	204,212	1,189,740	..	1,189,740
Arkansas	76,898	61	76,959	2,495,949	3,432	2,499,381
California . . .	569,463	109,389	678,852	7,307,059	549,718	7,856,777
Colorado	110,392	17,675	128,067	379,839	61,748	441,587
Florida	40,224	621	40,845	294,854	2,000	296,854
Georgia	27,924	1,145	29,069	367,991	12,421	380,412
Idaho	279,651	8,712	288,363	2,465,088	22,307	2,487,395
Illinois	4,056	22	4,078	45,371	1,350	46,721
Indiana	371	..	371	3,427	..	3,427
Kentucky	11,479	..	11,479	110,439	..	110,439
Louisiana	40,516	..	40,516	539,240	..	539,240
Maine	1,881	..	1,881	15,234	..	15,234
Michigan	65,301	1,523	66,824	388,749	21,960	410,709
Minnesota	94,552	13,446	107,998	383,406	40,912	424,318
Mississippi . . .	96,869	..	96,869	1,202,278	..	1,202,278
Missouri	25,005	949	25,954	122,854	5,033	127,887
Montana	164,679	16,858	181,537	816,475	71,708	888,183
Nebraska	6	..	6	26	..	26
Nevada	345	..	345	1,135	..	1,135
New Hampshire . .	17,700	..	17,700	141,920	..	141,920
New Mexico . . .	56,331	3,763	60,094	322,845	15,118	337,963
North Carolina .	33,218	580	33,798	281,912	8,635	290,547
Ohio	236	..	236	2,303	..	2,303
Oklahoma	1,866	..	1,866	18,359	..	18,359
Oregon	1,251,280	70,106	1,321,386	16,206,239	325,731	16,531,970
Pennsylvania . .	7,422	..	7,422	99,182	..	99,182
Puerto Rico . . .	418	..	418	5,986	..	5,986
South Carolina .	29,140	293	29,433	526,177	17,181	543,358
South Dakota . .	40,953	58	41,011	215,043	560	215,603
Tennessee	18,918	144	19,062	192,261	2,476	194,737
Texas	82,568	..	82,568	1,240,097	..	1,240,097
Utah	40,185	1,817	42,002	163,508	5,918	169,426
Vermont	11,513	..	11,513	142,224	..	142,224
Virginia	21,839	..	21,839	145,775	..	145,775
Washington . . .	776,067	16,119	792,186	7,565,262	83,377	7,648,639
West Virginia . .	15,141	..	15,141	126,832	..	126,832
Wisconsin	52,881	3,199	56,080	290,349	32,273	322,622
Wyoming	54,726	..	54,726	191,726	..	191,726
Totals - 1951	4,421,800	266,480	4,688,280	46,532,531	1,283,858	47,816,389*
Totals - 1950	3,194,581	307,356	3,501,937	29,084,440	1,629,852	30,714,292*

*In addition, forest products not convertible into board feet were cut, the value of which was \$177,578 in 1951 and \$210,763 in 1950.

Table 4. - FOREST TREE PLANTING AND SOWING ON THE NATIONAL FORESTS, BY STATES

FISCAL YEAR 1951

State	Acres Planted and Seeded ^{1/}				
	Fiscal Year 1951	Previous Years	Total to Date	Lost From All Causes	Net Total To Date
Alabama	3,281	36,257**	39,538	2,441	37,097
Arizona	..	1,033	1,033	260	773
Arkansas	36	14,337	14,373	4,900	9,473
California	3,669	33,117***	36,786	10,762	26,024
Colorado	780	66,110	66,890	28,614	38,276
Florida	703	8,678	9,381	765	8,616
Georgia	92	3,004	3,096	57	3,039
Idaho	1,221	95,432	96,653	26,460	70,193
Illinois	2,137	27,751	29,888	1,522	28,366
Indiana	1,428	8,511	9,939	468	9,471
Kentucky	22	379	401	..	401
Louisiana	..	98,219	98,219	21,170	77,049
Maine	..	67*	67	..	67
Michigan	6,437	519,348	525,785	152,517	373,268
Minnesota	2,292	122,253	124,545	31,745	92,800
Mississippi	4,087	126,256	130,343	4,502	125,841
Missouri	2,342	52,324	54,666	12,704	41,962
Montana	773	33,219	33,992	12,940	21,052
Nebraska	..	29,546	29,546	13,658	15,888
Nevada	..	42	42	42	..
New Hampshire	..	1,153	1,153	145	1,008
New Mexico	..	2,003	2,003	999	1,004
North Carolina	1,313	4,450	5,763	345	5,418
Ohio	996	5,288	6,284	864	5,420
Oklahoma	..	57	57	57	..
Oregon	5,710	50,196	55,906	5,573	50,333
Pennsylvania	56	16,862	16,918	4,698	12,220
Puerto Rico	204	11,169	11,373	8,123	3,250
South Carolina	1,188	13,607	14,795	182	14,613
South Dakota	721	27,511	28,232	6,072	22,160
Tennessee	27	2,713	2,740	68	2,672
Texas	..	48,581	48,581	12,099	36,482
Utah	14	3,978	3,992	2,368	1,624
Vermont	168	1,107	1,275	..	1,275
Virginia	79	1,576	1,655	423	1,232
Washington	3,725	82,712	86,437	10,004	76,433
West Virginia	259	15,092	15,351	732	14,619
Wisconsin	2,115	215,677	217,792	50,372	167,420
Wyoming	246	5,653	5,899	3,321	2,578
Totals	46,121	1,785,268	1,831,389	431,972	1,399,417

* Adjustment (-34 acres previous years)

** Adjustment (-26 acres previous years)

***Adjustment (-66 acres previous years)

^{1/} Includes States where there was some direct seeding as follows:

State	Acres Seeded F.Y. 1951
Colorado	2
Idaho	8
Mississippi	550
Missouri	4
Montana	11
Oregon	200
South Dakota	261
Washington	4
Wyoming	59
Total Seeding	1,099

TABLE 5 - PAY PERMITS ISSUED AND NUMBERS OF LIVESTOCK PERMITTED
TO GRAZE UNDER PAY PERMITS ON THE NATIONAL FORESTS, BY STATES,
CALENDAR YEAR 1950.

State	Cattle and Horses		Sheep and Goats	
	Permits Issued	Number Allowed	Permits Issued	Number Allowed
Alabama	1	20	..	..
Arizona	844	134,545	29	88,938
Arkansas	191	2,459	..	..
California	1,273	106,139	86	120,689
Colorado	1,838	157,557	517	608,909
Florida	26	2,769	..	..
Idaho	1,904	103,690	367	599,894
Illinois	34	210	..	..
Indiana	13	55	..	..
Iowa	11	215	..	..
Louisiana	19	964	..	..
Michigan	135	1,630	5	257
Minnesota	64	633	2	54
Mississippi	65	1,342	..	..
Missouri	441	2,902	2	18
Montana	1,678	110,079	171	246,534
Nebraska	57	12,748	..	..
Nevada	270	51,652	49	134,736
New Mexico	1,785	77,150	168	103,876
North Carolina	24	40	..	..
Ohio	33	158	..	..
Oklahoma	5	30	..	..
Oregon	855	68,465	105	149,455
Pennsylvania	11	43	..	..
South Carolina	25	389	..	..
South Dakota	638	24,268	25	15,722
Tennessee	10	115	..	..
Texas	47	1,303	..	..
Utah	3,349	106,397	770	482,641
Vermont	11	79	..	..
Virginia	31	210	5	166
Washington	452	18,729	29	35,127
West Virginia	108	1,198	47	1,367
Wisconsin	30	374	..	..
Wyoming	985	103,123	235	417,802
Totals	17,263	1,091,680	2,612	3,006,185

Table 6. - ESTIMATE OF BIG GAME ANIMALS ON
NATIONAL FORESTS

AS OF JUNE 30, 1950

State	Antelope	Bear		Deer			Elk	Moose	Mountain Goat	Bighorn	Peccary	Wild Boar	Total* Big Game
		Black	Grizzly and Alaska Brown	Whitetail	Mule	Blacktail							
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
Alabama . .	..	10	..	1,700	..	..	..	..	..	..	..	..	1,700
Arizona . .	5,500	1,000	..	15,000	57,000	..	7,800	..	..	70	13,000	..	99,000
Arkansas . .	..	15	..	18,000	..	..	230	..	..	..	..	..	18,000
California .	2,800	17,000	..	..	279,000	166,000	120	..	..	470	..	400	466,000
Colorado . .	160	6,600	..	..	228,000	..	32,000	..	20	3,300	..	..	270,000
Florida . .	..	500	..	7,300	..	..	..	..	..	..	..	..	7,800
Georgia . .	..	50	..	4,700	..	..	..	..	..	..	..	..	4,800
Idaho . . .	6,900	8,300	40	22,000	135,000	..	41,000	1,700	3,800	2,300	..	..	221,000
Illinois . .	..	..	..	340	..	..	..	..	..	..	..	..	340
Indiana . .	..	..	..	1,500	..	..	..	..	..	..	..	..	1,500
Kentucky . .	..	5	..	200	..	..	..	..	..	..	..	..	200
Louisiana .	..	2	..	700	..	..	..	..	..	..	..	..	700
Maine . . .	..	30	..	500	..	..	..	10	..	..	..	..	540
Michigan . .	..	3,700	..	176,000	..	..	..	..	..	..	..	..	180,000
Minnesota .	..	4,400	..	57,000	..	..	..	470	..	..	..	..	62,000
Mississippi .	..	10	..	5,200	..	..	..	..	..	..	..	..	5,200
Missouri . .	..	..	..	15,000	..	..	..	..	..	..	..	..	15,000
Montana . .	2,900	6,700	590	38,000	98,000	..	32,000	3,500	4,000	1,200	..	..	187,000
Nebraska . .	..	..	..	10	350	..	..	..	..	..	..	..	360
Nevada . . .	380	30	..	..	67,000	..	500	..	..	230	..	..	68,000
New Hampshire	..	280	..	1,600	..	..	..	7	..	..	..	..	1,900
New Mexico .	2,100	1,300	..	6,500	53,000	..	2,000	..	..	130	550	..	66,000
North Carolina	..	620	..	11,000	..	..	7	..	..	..	..	350	12,000
Ohio	..	..	..	500	..	..	..	..	..	..	..	..	500
Oklahoma . .	..	5	..	400	..	..	..	..	..	..	..	..	400
Oregon . . .	1,300	6,800	..	25	141,000	36,000	25,000	..	5	..	..	..	210,000
Pennsylvania	..	380	..	30,000	..	..	..	..	..	..	..	..	30,000
South Carolina	..	15	..	2,100	..	..	..	..	..	..	..	..	2,100
South Dakota	3,100	..	..	40,000	16,000	..	400	..	300	..	..	..	60,000
Tennessee .	..	250	..	4,400	..	..	..	..	..	..	..	550	5,200
Texas . . .	..	..	..	5,200	..	..	..	..	..	..	..	..	5,200
Utah	300	430	..	..	184,000	..	5,000	5	..	10	..	..	190,000
Vermont . .	..	500	..	6,000	..	..	..	..	..	..	..	..	6,500
Virginia . .	..	1,300	..	30,000	..	..	35	..	..	..	..	..	31,000
Washington .	..	12,000	15	8,900	44,000	23,000	16,000	..	5,800	10	..	..	110,000
West Virginia	..	850	..	18,000	..	..	..	..	..	..	..	..	19,000
Wisconsin .	..	1,200	..	98,000	..	..	..	..	..	..	..	..	99,000
Wyoming . .	1,700	2,700	150	4,700	47,000	..	35,000	3,600	..	2,100	..	..	97,000
Total,* United States	27,000	77,000	800	631,000	1,350,000	225,000	198,000	9,300	14,000	9,800	14,000	1,300	2,560,000
Alaska . . .	..	13,000	6,000	..	..	29,000	250	610	6,600	500	..	..	56,000
Total,* National Forests .	27,000	90,000	6,800	631,000	1,350,000	254,000	198,000	9,900	21,000	10,000	14,000	1,300	2,620,000

* Totals have been rounded off to nearest hundred or thousand.

Table 7 - NUMBER OF VISITS TO THE NATIONAL FORESTS FOR UTILIZATION OF THE RECREATION RESOURCES

CALANDAR YEAR 1950

Utilization of Recreation Resources										
State	Utilization of Improved Public Recreation Areas					Hotels or Resorts	Recreation Residences	Wilderness Areas	Other Forest Areas	Total
	Camp Grounds	Picnic Areas	Winter Sports Areas	Sub-total	Organization Camps					
	Number Visits	Number Visits	Number Visits	Number Visits	Number Visits					
Alabama	..	36,510	..	36,510	2,250	..	..	..	45,220	83,980
Alaska	1,060	22,350	6,032	29,442	590	2,990	12,554	50	55,930	101,556
Arizona	124,880	377,335	16,280	518,495	13,440	67,706	11,977	19,570	384,938	1,016,126
Arkansas	51,400	155,470	..	206,870	13,950	96,000	2,810	..	105,000	424,630
California	1,109,534	618,452	405,192	2,133,178	126,118	183,025	230,790	63,383	1,022,882	3,759,376
Colorado	289,375	597,370	144,430	1,031,175	12,145	512,996	28,615	10,840	658,605	2,254,376
Florida	27,700	239,200	..	266,900	63,500	1,050	9,025	..	147,300	487,775
Georgia	41,000	218,800	..	259,800	8,800	..	2,000	..	287,000	557,600
Idaho	270,393	215,256	126,275	611,924	12,212	47,865	23,488	12,911	433,778	1,142,178
Illinois	200	101,700	..	101,900	..	..	..	..	101,330	203,230
Indiana	50	30,100	..	30,150	..	..	..	..	62,000	92,150
Kentucky	..	13,140	..	13,140	280	..	..	..	40,850	54,270
Louisiana	..	33,000	..	33,000	..	..	22,370	..	6,200	61,570
Maine	700	3,600	..	4,300	..	500	..	..	3,000	7,800
Michigan	34,400	92,170	50,135	176,705	8,500	2,100	1,415	..	663,040	851,760
Minnesota	33,420	52,226	18,120	103,766	6,427	21,645	8,270	52,095	387,210	579,413
Mississippi	2,925	64,245	..	67,170	..	..	..	..	112,847	180,017
Missouri	10,700	68,140	..	78,840	486	..	..	..	530,905	610,231
Montana	115,021	189,660	18,515	323,196	23,795	54,155	60,116	9,990	421,363	892,615
Nebraska	..	21,000	..	21,000	..	..	..	..	3,000	24,000
Nevada	24,078	49,441	3,275	76,794	2,100	..	1,000	..	31,695	111,589
New Hampshire	21,310	84,886	52,530	158,726	..	125,500	..	100	269,750	554,076
New Mexico	67,392	184,181	18,210	269,783	7,110	2,095	3,175	7,210	296,591	585,964
North Carolina	142,550	482,765	..	625,315	3,042	178,400	620	14,940	408,200	1,230,517
Ohio	34,400	136,800	..	171,200	..	..	..	..	11,100	182,300
Oklahoma	..	8,800	..	8,800	..	..	..	..	6,500	15,300
Oregon	410,457	442,830	232,600	1,085,887	23,918	266,075	25,946	13,545	363,970	1,779,341
Pennsylvania	6,000	90,000	..	96,000	1,000	13,500	8,000	..	751,000	869,500
Puerto Rico	..	34,590	..	34,590	..	17,121	6,950	..	13,600	72,261
South Carolina	..	98,100	..	98,100	..	..	..	..	56,850	154,950
South Dakota	17,800	252,200	100	270,100	6,590	5,300	10,120	25	894,750	1,186,885
Tennessee	11,500	150,700	..	162,200	4,700	21,750	12,000	..	861,312	1,061,962
Texas	10,900	67,000	..	77,900	2,000	..	..	..	44,200	124,100
Utah	432,525	1,521,890	180,086	2,134,501	50,210	53,540	54,385	13,500	669,030	2,975,166
Vermont	700	49,000	..	49,700	..	..	..	..	3,000	52,700
Virginia	6,391	164,770	..	171,161	2,340	..	385	..	182,880	356,766
Washington	400,812	291,545	194,745	887,102	38,611	97,897	63,410	6,042	291,211	1,384,273
West Virginia	7,462	139,208	..	146,670	2,439	..	..	..	160,395	309,504
Wisconsin	13,220	70,970	8,150	92,340	2,940	205	1,160	..	210,200	306,845
Wyoming	138,590	108,175	29,900	276,665	14,120	130,725	26,900	21,605	199,130	669,145
Total	3,858,845	7,577,575	1,504,575	12,940,995	453,613	1,902,140	627,481	245,806	11,197,762	27,367,797

NOTE: In addition to the 27,367,797 visits to national forest recreation areas, some 56 million traveled highways and roads through the national forests in order to enjoy the natural forest environment, the scenery, and the climatic relief which the altitude and forest provide.

Table 8 - FIRES CONTROLLED BY NATIONAL FOREST FIRE ORGANIZATIONS TO PROTECT THE NATIONAL FOREST LANDS

CALENDAR YEAR 1950, AND
5-YEAR AVERAGE, 1946-1950

Item	Number of fires		Percentage of Totals	
	1950	Average 1946-50	1950	Average 1946-50
Class of Burns:				
0.25 acres or less.....	5,288	5,392	52.34	50.78
0.251 to 10 acres.....	3,477	3,688	34.42	34.74
Over 10 acres.....	1,338	1,537	13.24	14.48
Total.....	10,103	10,617	100.00	100.00
Causes:				
Lightning.....	4,471	4,587	44.25	43.21
Man-caused:				
Smokers	1,701	1,927	16.84	18.15
Incendiarism	1,724	1,717	17.06	16.17
Debris burning.....	470	547	4.65	5.15
Campfire.....	596	565	5.90	5.32
Railroad.....	234	330	2.32	3.11
Lumbering.....	187	172	1.85	1.62
Miscellaneous.....	720	772	7.13	7.27
Total, man-caused.....	5,632	6,030	55.75	56.79
Grand Total.....	10,103	10,617	100.00	100.00
Calendar Year	Total area of national forest land burned over		Total damage of national forest land burned over	
	Acres		Dollars	
1950.....	255,387		6,718,548	
5-year average 1946-1950	176,119		2,875,937	

Table 9.- NET CASH RECEIPTS FROM NATIONAL FORESTS

FISCAL YEAR 1951

Net receipts from national forests

From timber	\$51,098,565.11 ^a	
From forage	4,165,573.39	
From special lands uses, water power, etc.	<u>883,203.35</u>	
Total		<u>\$56,147,341.85^{b,c}</u>

Distribution of above total:

1. Amount appropriated for acquisition of lands in the following National Forests:

Forest	Amount
Angeles	\$ 20,000.00
Cache	10,000.00
Cleveland	7,745.14
Nevada	1,866.73
San Bernardino	16,571.05
Sequoia	34,850.00
Toiyabe	8,133.27
Uinta	27,367.79
Wasatch	<u>12,462.21</u>

Total appropriated for land acquisition \$138,996.19

2. Payments to Arizona and New Mexico, account school lands administered by Forest Service 107,293.67
3. Payment to State of Minnesota representing 3/4 of 1 percent of appraised value of national forest land in Cook, Lake and St. Louis Counties under Act of June 22, 1948, (62 Stat. 568) 44,810.14
4. Payments to States in which national forests are located, under Act of May 23, 1908 13,974,027.19^{d,e}
5. Amount appropriated for expenditure by Forest Service for improvement of the range under section 12 of the Act of April 24, 1950 700,000.00
6. Amount appropriated for expenditure by Forest Service for Roads and Trails, under Act of March 4, 1913 5,590,105.20
7. Net amount to United States Treasury 35,592,109.46^e
- Total \$56,147,341.85

^a

In addition to the cash receipts from timber, there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$1,283,858.00.

^b

This total exceeds the receipts for the previous year by \$22,552,728.03. Receipts from timber increased \$21,719,348.49; grazing increased \$780,569.78; and miscellaneous increased \$52,809.76.

^c

Additional receipts, primarily from the sale of timber, are being held in suspense pending determination of the status of the lands from which such receipts were derived as follows:

Oregon and California Railroad Grant Lands . .	\$1,266,898.20
Tongass National Forest, Alaska	<u>146,048.86</u>
Total	<u>\$1,412,947.06</u>

^d

Computed on the basis of total receipts after deduction of (a) 1 and 2 above and (b) \$4,943.22 collected in the counties of Cook, Lake, and St. Louis in the Superior National Forest, State of Minnesota to which the Act of May 23, 1908 does not apply.

^e

Subject to possible change of not more than \$233,333.33 to meet the matching requirements of the Cooperative Range Improvement Appropriation.

Table 10. - PREVENTION AND SUPPRESSION EXPENDITURES FOR FOREST FIRE CONTROL
ON STATE AND PRIVATE FOREST LANDS, BY STATES
FISCAL YEAR 1951

(Clarke-McNary Law, Act of June 7, 1924)

STATE	EXPENDITURES			
	Federal Participation	State and County	Private Agencies	Total
	Dollars	Dollars	Dollars	Dollars
Alabama	332,638	589,726	85,962	1,008,326
Arkansas	270,476	471,006	73,383	814,865
California	1,637,621	6,499,906	—	8,137,527
Colorado	27,647	33,636	20,000	81,283
Connecticut	49,025	96,116	—	145,141
Delaware	11,500	12,736	—	24,236
Florida	465,553	727,039	507,776	1,700,368
Georgia	331,027	1,185,248	5,377	1,521,652
Hawaii	4,500	5,867	—	10,367
Idaho	136,440	80,210	178,775	395,425
Illinois	25,000	49,845	—	74,845
Indiana	57,885	102,669	—	160,554
Iowa	17,736	17,736	—	35,472
Kentucky	100,308	139,726	—	240,034
Louisiana	258,740	743,926	—	1,002,666
Maine	188,364	665,058	—	853,422
Maryland	99,423	319,690	—	419,113
Massachusetts	90,931	292,127	—	383,058
Michigan	431,640	1,045,313	—	1,476,953
Minnesota	268,736	572,102	—	840,838
Mississippi	259,703	796,442	—	1,056,145
Missouri	192,413	412,224	—	604,637
Montana	76,625	31,333	101,346	209,304
Nevada	15,715	20,277	—	35,992
New Hampshire	69,429	121,026	36,773	227,228
New Jersey	105,717	263,340	—	369,057
New Mexico	5,440	5,285	—	10,725
New York	243,288	716,998	—	960,286
North Carolina	255,626	563,457	18,538	837,621
Ohio	57,088	113,937	—	171,025
Oklahoma	58,850	146,982	17,975	223,807
Oregon	708,166	702,248	832,679	2,243,093
Pennsylvania	199,790	470,681	—	670,471
Rhode Island	26,847	65,836	13,660	106,343
South Carolina	320,191	505,447	—	825,638
South Dakota	25,000	26,360	5,783	57,143
Tennessee	123,215	320,220	4,583	448,018
Texas	168,654	288,529	56,528	513,711
Utah	30,000	44,545	—	74,545
Vermont	25,000	32,528	9,441	66,969
Virginia	192,279	460,558	2,273	655,110
Washington	583,556	1,062,789	299,624	1,945,969
West Virginia	163,462	263,196	8,879	435,537
Wisconsin	284,932	800,602	—	1,085,534
Totals	8,996,176	21,884,522	2,279,355	33,160,053

Table 11. - DISTRIBUTION OF FOREST PLANTING STOCK
BY COOPERATING STATES. FISCAL YEAR 1951

(Clarke-McNary Law, June 7, 1924, as amended)

STATE	EXPENDITURES			
	Federal Funds	State Appropriated Funds	Receipts From Sale of Stock Used in Program	Total
	Dollars	Dollars	Dollars	Dollars
Alabama	11,012	42,717	29,183	82,912
Arizona	No program			
Arkansas	10,634	12,518	32,167	55,319
California	No program			
Colorado	2,476	2,476	9,903	14,855
Connecticut	4,508	8,888	12,478	25,874
Delaware	2,500	6,554	322	9,376
Florida	11,012	46,406	40,219	97,637
Georgia	11,011	38,605	91,173	140,789
Hawaii	10,653	21,103	All free	31,756
Idaho	4,182	4,182	10,816	19,180
Illinois	10,819	141,938	29,399	182,156
Indiana	10,819	83,875	61,902	156,596
Iowa	2,498	5,177	5,578	13,253
Kansas	No program			
Kentucky	10,634	17,728	5,668	34,030
Louisiana	11,011	76,414	84,067	171,492
Maine	5,698	5,698	1,525	12,921
Maryland	10,969	35,964	1,683	48,616
Massachusetts	10,250	25,650	5,027	40,927
Michigan	10,634	28,717	25,190	64,541
Minnesota	No program			
Mississippi	10,928	44,079	31,269	86,276
Missouri	9,652	20,182	4,962	34,796
Montana	10,586	10,586	20,081	41,253
Nebraska	132	132	31,800	32,064
Nevada	No program			
New Hampshire	10,969	11,042	6,283	28,294
New Jersey	10,969	30,936	8,331	50,236
New Mexico	No program			
New York	10,974	235,441	42,623	289,038
North Carolina	11,012	74,489	24,455	109,956
North Dakota	9,500	10,464	3,788	23,752
Ohio	10,819	80,710	37,859	129,388
Oklahoma	11,018	30,149	12,162	53,329
Oregon	10,634	15,038	12,141	37,813
Pennsylvania	11,847	115,920	111,127	238,894
Puerto Rico	9,494	15,811	All free	25,305
Rhode Island	No program			
South Carolina	11,012	36,692	34,219	81,923
South Dakota	6,586	6,586	44,069	57,241
Tennessee	10,000	11,077	4,182	25,259
Texas	2,194	2,205	53,128	57,527
Utah	2,700	2,798	4,087	9,585
Vermont	10,969	20,875	7,720	39,564
Virginia	10,969	27,730	13,283	51,982
Washington	8,561	8,561	7,325	24,447
West Virginia	10,634	17,805	14,198	42,637
Wisconsin	10,829	124,119	103,249	238,197
Wyoming	2,437	2,437	4,796	9,670
Totals	376,745	1,560,474	1,083,437	3,020,656

Table 12. - NORRIS-DOXEY FARM WOODLAND MANAGEMENT ACCOMPLISHMENTS
AND EXPENDITURES 1/. FISCAL YEAR 1951

STATE	ACCOMPLISHMENTS				EXPENDITURES		
	Farmers Assisted	Woodland Involved	Products Harvested	Gross Sale Value	Federal	State	Total
	Number	Acres	M bd. ft.	Dollars	Dollars	Dollars	Dollars
Alabama	1,107	178,477	99,736	2,647,076	30,250	33,873	64,123
Arkansas	364	37,514	3,344	62,711	13,610	13,757	27,367
California	452	212,796	50,119	328,886	8,889	50,047	58,936
Colorado	68	30,315	1,166	13,546	1,437	1,438	2,875
Connecticut	512	17,635	2,531	33,088	11,494	12,765	24,259
Delaware	70	3,275	78	1,720	2,482	2,508	4,990
Florida	897	359,962	32,254	500,931	21,332	24,411	45,743
Georgia	511	156,533	11,710	253,307	17,250	18,500	35,750
Idaho	206	6,883	4,249	48,319	4,169	4,169	8,338
Illinois	734	25,731	5,938	155,813	26,918	37,602	64,520
Indiana	414	15,669	1,535	62,476	12,794	13,223	26,017
Iowa	236	12,041	1,656	50,711	7,836	16,874	24,710
Kentucky	423	24,185	7,111	154,275	17,059	17,950	35,009
Louisiana	199	16,454	4,373	79,955	3,958	3,958	7,916
Maine	434	16,039	8,499	144,782	5,701	5,701	11,402
Maryland	914	46,330	23,654	586,858	19,339	22,143	41,482
Massachusetts	217	9,732	1,985	29,707	5,223	5,223	10,446
Michigan	729	18,049	8,266	237,039	21,693	31,285	52,978
Minnesota	367	19,074	2,887	86,217	-	20,059	20,059
Mississippi	587	84,628	12,938	364,641	11,491	11,693	23,184
Missouri	894	148,844	9,748	252,251	29,976	38,747	68,723
New Hampshire	982	70,811	30,512	549,246	19,000	22,097	41,097
New Jersey	633	55,552	9,049	99,677	6,000	15,792	21,792
New York	2,733	187,458	47,129	962,853	21,464	127,471	148,935
North Carolina	690	94,157	29,185	647,444	22,550	24,183	46,733
North Dakota	66	4,656	1,778	89,900	2,750	2,959	5,709
Ohio	607	20,760	4,667	149,410	13,490	13,844	27,334
Oklahoma	256	4,585	458	17,648	5,582	5,582	11,164
Oregon	446	19,261	42,821	783,432	8,389	13,444	21,833
Pennsylvania	768	30,854	7,583	166,870	19,805	23,075	42,880
South Carolina	586	107,231	12,611	383,187	16,025	19,526	35,551
Tennessee	553	32,881	14,217	308,870	14,423	14,423	28,846
Texas	383	85,155	3,548	81,736	10,304	10,304	20,608
Vermont	1,245	74,471	24,396	799,700	30,034	34,945	64,979
Virginia	2,030	202,216	159,014	3,754,906	29,566	86,843	116,409
Washington	648	33,423	25,578	472,840	12,058	13,444	25,502
West Virginia	933	45,262	3,359	84,556	18,666	37,394	56,060
Wisconsin	1,458	49,192	12,256	495,356	25,601	34,998	60,599
Total U.S.	25,352	2,558,091	721,938	15,941,940	548,608	886,250	1,434,858

U.S. Summary

F.Y. 1940)					4,793	8,284	13,077
F.Y. 1941) 2/	165	49,416	2,667	31,483	15,342	17,120	32,462
F.Y. 1942	224	92,442	10,076	125,307	18,171	19,579	37,750
F.Y. 1943	3,242	359,388	75,600	1,043,878	101,076	111,559	212,635
F.Y. 1944	8,842	742,697	323,557	3,962,784	187,316	212,209	399,525
F.Y. 1945	8,093	831,347	411,330	4,476,354	199,995	230,865	430,860
F.Y. 1946	12,083	1,321,746	452,367	6,092,499	315,441	369,065	684,506
F.Y. 1947	13,531	1,576,888	502,312	7,805,105	344,720	449,626	794,346
F.Y. 1948	14,220	1,399,971	503,641	7,668,499	353,179	467,129	820,308
F.Y. 1949	17,140	1,769,240	437,903	7,721,865	349,117	573,882	922,999
F.Y. 1950	22,828	2,542,564	518,566	9,421,220	538,812	726,973	1,265,785

1/ 243 Projects

2/ F.Y. 1940 and F.Y. 1941 Accomplishments Combined

Table 13. - FOREST FIRES ON PROTECTED STATE AND PRIVATE LANDS

NUMBER BY SIZE, AREA PROTECTED, AND AREA BURNED OVER

CALENDAR YEAR 1950

State	Number of Fires				Area Protected	Area Burned Over
	Under 0.25 Acres	0.25 - 10.0 Acres	Over 10 Acres	Total		
	Number	Number	Number	Number	M Acres	Acres
Alabama	146	4,276	5,689	10,111	18,112	418,218
Arizona	Data Incomplete					
Arkansas	590	2,465	1,475	4,530	12,405	82,731
California	1,347	803	406	2,556	19,500	270,150
Colorado	109	106	75	290	7,160	24,871
Connecticut	110	432	33	575	1,907	1,997
Delaware	15	63	6	84	440	342
Florida	285	4,904	4,888	10,077	12,938	377,377
Georgia	1,510	4,238	3,963	9,711	13,967	297,792
Hawaii	—	3	5	8	1,735	189
Idaho	284	103	84	471	6,963	20,236
Illinois	13	54	99	166	3,755	7,036
Indiana	28	129	78	235	4,255	3,880
Iowa	4	16	37	57	1,968	3,222
Kentucky	5	285	764	1,054	4,603	28,795
Louisiana	106	2,626	2,499	5,231	9,564	281,623
Maine	327	483	142	952	16,692	18,052
Maryland	152	432	48	632	2,686	2,978
Massachusetts	646	1,154	110	1,910	3,293	9,954
Michigan	186	675	109	970	17,124	6,025
Minnesota	241	294	138	673	17,996	8,872
Mississippi	327	6,538	5,010	11,875	11,286	232,643
Missouri	307	1,652	1,098	3,057	6,984	79,291
Montana	185	29	10	224	6,000	894
Nebraska	Data Incomplete					
Nevada	14	20	8	42	2,150	2,023
New Hampshire	216	365	48	629	4,176	6,147
New Jersey	361	707	110	1,178	2,294	12,026
New Mexico	47	29	14	90	1,105	34,849
New York	271	825	175	1,271	13,423	8,181
North Carolina	199	1,554	2,340	4,093	15,153	461,600
North Dakota	Data Incomplete					
Ohio	119	335	258	712	4,973	15,611
Oklahoma	47	461	467	975	3,419	86,781
Oregon	708	338	112	1,158	11,995	18,717
Pennsylvania	53	525	332	910	14,659	36,775
Rhode Island	112	151	30	293	452	4,135
South Carolina	481	4,406	3,069	7,956	11,300	229,908
South Dakota	57	26	3	86	896	3,293
Tennessee	143	2,062	1,029	3,234	6,473	57,221
Texas	216	932	1,341	2,489	7,525	158,319
Utah	24	45	41	110	5,721	6,790
Vermont	58	120	21	199	3,504	875
Virginia	330	1,326	427	2,083	12,971	19,563
Washington	795	399	51	1,245	12,329	3,896
West Virginia	90	761	829	1,680	9,038	61,271
Wisconsin	289	379	28	696	15,590	2,334
Wyoming	Data Incomplete				85	
Totals	11,553	47,526	37,499	96,578	360,564	3,407,483

Table 14.- STATEMENT OF EXPENDITURES FROM APPROPRIATIONS AND ALLOCATIONS TO THE FOREST SERVICE

FISCAL YEAR 1951

(Classified by Primary Purpose of Appropriation)

General Administration		\$ 648,728
National Forests		
Operation and Protection		
National Forest Protection and Management	\$27,047,010	
Fighting Forest Fires	6,095,741	
Blister Rust Control	1,773,884	
Forest Pest Control	3,129,897	
Cooperative Range Improvements	<u>472,041</u>	
		\$38,518,573
Forest Roads and Trails		
Forest Development, Roads and Trails	13,090,965	
Forest Highways (Commerce Dept.) (F.S. Administration). .	98,284	
10% Fund for States	<u>2,858,284</u>	
		16,047,533
Acquisition of Land		<u>389,384</u>
Total, National Forests		\$54,955,490
Research		
Forest and Range Management Investigations	2,945,627	
Forest Products	1,265,855	
Forest Resources Investigations	834,259	
Research and Marketing Act	<u>43,679</u>	
Total, Research		5,089,420
State and Private Forest Land Items		
Forest Fire Cooperation	9,458,033	
Farm & Other Private Forestry Cooperation	<u>1,176,585</u>	
Total, State and Private		10,634,618
Flood Control		
Preliminary Examinations and Surveys	689,259	
Works of Improvement	<u>991,492</u>	
Total, Flood Control		1,680,751
Services Performed for and Financed by Other Federal Agencies		
Housing and Home Finance Agency	140,499	
Production & Marketing Administration (Agriculture)	122,673	
Department of Interior	130,233	
Department of the Navy	158,952	
Department of the Army	608,378	
Department of Commerce	78,367	
Farmers Home Administration (Agriculture)	13,166	
Defense Production (Ex. Office of the President)	164,326	
Economic Cooperation Administration	8,030	
Miscellaneous	<u>46,022</u>	
Total, Services for and Financed by Other Federal Agencies		1,470,646
Cooperative Work Financed by States, Counties, Organizations, and Individuals. Includes fire control on intermingled private land, construction and maintenance of improvements, investigative work, slash disposal, etc.		
Deposited Cooperation	5,683,441	
Undeposited Cooperation	<u>207,947</u>	
Total, Cooperative Work		5,891,388
Total, Net Expenditures		\$80,371,041
Expenditures from Proceeds of Sale of Parts and Equipment		449,225
Additional Expenditures for which the Appropriations were Reimbursed:		
Forest Service Units and Other Government Agencies	4,547,408	
Non-Federal Agencies	<u>403,427</u>	
Total, Appropriation Reimbursements		4,950,835
Grand Total		<u>\$85,771,101</u>

